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An Investigation of the SOAR Study Strategy for Learning from Multiple Online Resources

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By

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This dissertation investigated the effects of the SOAR study strategy for learning from multiple online resources. SOAR includes the components of Selection, Organization, Association, and Regulation. In past research, the effects of SOAR training were investigated with one online resource and with students studying provided or partially provided materials following training. This dissertation examines the effects of SOAR when learning from multiple online resources and when students create their own study materials following training and thus addresses this research gap. One hundred thirty-four (134) college students were assigned randomly to the control or experimental groups. All students participated in online training in their respective study strategy. Both groups studied the same materials. The experimental group was taught to use SOAR, whereas the control group used their preferred study strategies. Following training, both groups were presented with the same online materials. Participants in the experimental group studied using SOAR and were prompted to take notes and create study materials based on SOAR components. The control group participants studied the material using their preferred study strategies. They created notes and developed study materials of their choice. Both groups were given time to study. Following the study period, participants were tested on the online material with respect to fact, relationship, and concept learning.

After testing, all participants completed an attitudinal survey regarding their experiences. Follow-up interviews were conducted with participants from each group in the following five weeks. Results showed that students who use SOAR when learning from multiple online resources score higher on fact, concept, and relationship items and created higher quality study materials than students who followed their preferred study strategies. Findings showed that without instruction, students use ineffective study strategies when learning from multiple online resources. SOAR training changed college students' study behavior and raised achievement.

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Chapter One

Introduction

Imagine that students are preparing for an exam on the topic of Apes. What if the information they are studying exists on several webpages and contains over 20 ideas and facts like the texts in Table 1? How would they go about studying the material in preparation for an exam?

Table 1

Examples of Ape Text From Multiple Online Resources

Gibbons
Gibbons are so dexterous while moving in the trees, almost no predators can catch them. This ape moves from one tree to another reaching speeds of 35 mph. Because of their small sizes their only protection comes from brachiating away when confronted. They are about 2 feet tall and weigh about 20 pounds. They cannot swim, but because they are omnivores that eat both plants and meat, they can survive in several areas of a forest living in the trees.
Orangutans
Orangutans weight an average of 200 pounds with an average height of 5 feet. They can reach a speed of 15 mph. Only when under attack these omnivores have been known to gather in their groups and make loud noises to scare others away. Although they are known to swing in trees, they spend most of their lives in on the ground. Their man means man of the forest. They are known for caring for their young as a group.
Gorillas
Gorillas are large apes that weight 300 lbs and are on average at 6 feet tall. Despite their size, they rarely attack other animals. In fact, Gorillas are herbivores, eating mostly plant material. They are the least aggressive of the apes, despite their size. When an intruder disturbs them, they may gather in their group and make a lot of noise as a display of power. Males are called silverbacks. They reach about 10 mph swinging in trees but spend their lives on the ground.

Research examining college students' study behavior shows that students develop poor study habits and use ineffective study strategies (Gubbels, 1999; Jairam, 2009; Kiewra & DuBois, 1991; Pressley, Yokoi, van Meter, Van Etten, & Freebern, 1997). In

fact, 73% of college students report difficulties preparing for exams (Rachal, Daigle, & Rachal, 2007). Moreover, researchers identify four main areas of students' weak study strategies: (a) incomplete notes, (b) disorganized ideas, (c) piecemeal learning, and (d) redundant strategies (Jairam & Kiewra, 2009; Kiewra, 1985b; Rachal et al., 2007).

Given these study problems, it is likely that when students study the texts in Table 1 in preparation for an exam, they will skim through the webpages and take incomplete notes that miss important ideas. The reality is that college students are poor note-takers who tend to omit 70% of critical information from their notes, leaving them with insufficient material for review (Armbruster, 2000; Kiewra, 1985a, 1985b; Titsworth, 2004).

Moreover, the notes students do take are in a linear fashion and lack organization (Jairam & Kiewra, 2009; Kiewra, 2004). An example of disorganized and incomplete notes from the Ape texts is shown in Figure 1. This figure illustrates an example of incomplete notes from the ape text in Table1.

Notice how Figure 1 notes are missing several key text ideas like defense mechanism for each ape or unique facts like *Gibbons cannot swim*. Another noticeable issue is that notes do not provide complete descriptions of ideas. For example, the student wrote the number "10" under the *Gorillas* heading without explaining that it represents speed of apes in trees. In addition, the ideas are presented in lists. The student separated related information making it difficult to identify relationships across apes. For example,

Incomplete notes
Gibbons 35 mile per hour swinging in trees. 20 pounds omnivores Orangutans 200 pounds 15 mph omnivores Gorillas are 6 feet weight 300 pounds 10 herbivores

Figure 1. Incomplete notes example.

the diet for each ape was listed under the ape's name making it difficult to identify the number of apes that are omnivores. Disorganized study materials make it difficult for students to compare and contrast ideas, develop meaningful relationships between topics, and associate ideas across multiple texts (Jairam & Kiewra, 2010; Rachal et al., 2007). For example, the student might memorize the weight and speed for each ape, yet fail to ascertain the relationship between the two categories: *the smaller the ape, the faster its speed in trees.*

Furthermore, the student might rely on repetitive strategies such as reciting, rehearsal, and rewriting information when studying. All these are commonly used ineffective study strategies (Kiewra & DuBois, 1991; Weinstein & Mayer, 1986). These

ineffective strategies are especially problematic when combined with incomplete notes and disorganized study materials (Rachal et al., 2007).

One means for combating such ineffective strategies is the SOAR study strategy. The present study investigated the effects of the SOAR study strategy on college students' learning from multiple online resources. The SOAR study strategy was developed to help students study (Kiewra, 2004) and help instructors teach (Kiewra, 2009). SOAR is an acronym for the strategy's four components: select, organize, associate, and regulate. Each component addresses a common learning problem and offers an effective learning strategy supported by research.

Why SOAR Works

The value of the SOAR study strategy stems from the cognitive processes on which its four components were built. Each component is theoretically rooted in the information processing view of cognitive psychology (Jairam, 2009). Table 2 presents the four SOAR components, the ineffective learning strategies each combats, and the cognitive process supporting each component.

As shown in Row 2 of Table 2, the select component addresses the cognitive process of attention. Attention is the first step to learning (Mayer, 1984; Sternberg, 1985). Select can help students create a complete set of notes containing all of the important ideas. Taking notes increases attention and results in improved achievement (Baker & Lombardi, 1985; Kiewra, 1985b).

Table 2

SOAR Component, Cognitive Process, Ineffective Study Strategy, and How SOAR can Help

SOAR Component → Cognitive Process	Ineffective study strategies commonly used by students	How can SOAR help?
Select → Attention	Record incomplete notes	Select all important ideas and create complete notes
Organize → Storage	Create a set of linear notes	Use graphic organizers to organize ideas
Associate → Encoding	Learn in a piecemeal fashion	Associate ideas to one another and what I already know.
Regulate → Metacognition	Redundant strategies like rehearsal and memorization	Generate practice test questions

As seen in Row 3 of Table 2, organization aids information storage. By using SOAR, students are encouraged to create a graphic organizer such as a table, matrix, chart, or hierarchy to summarize main ideas. Memory storage is optimized when ideas are presented logically and economically in an organizer (Jairam & Kiewra, 2010). Research confirms that using graphic organizers has an achievement advantage over using linear notes (Kiewra, Kauffman, Robinson, DuBois, & Staley, 1999).

In terms of association, as seen in Row 4 of Table 2, SOAR aids encoding by helping students identify relationships and associate ideas to each other. Research confirms that students using association strategies learn more than students using a piecemeal approach (King, 1992). Students can use an organizer to quickly identify relationships across several topics.

Finally, SOAR supports metacognition by encouraging students to generate test questions to regulate their learning as presented in Row 5 of Table 2. Research confirms that practice testing aids achievement (Karpicke & Blunt, 2011).

Now that we are familiar with the SOAR study strategy and its four theory based components, let us return to the ape text example in Table 1. How could the student study three ape texts using SOAR?

Select. The student could begin by selecting all important information in the texts to create a complete set of notes for later review. To illustrate the difference between incomplete and complete notes, examine Figure 2 that shows complete notes recorded from the ape text in Table 1 versus incomplete notes. As shown in Column 2 of Figure 2, the complete notes include all 24 facts about the three apes, whereas the incomplete notes are missing several important ideas and capture only 10 facts. This figure illustrates differences between complete and incomplete notes from the ape text in Table 1.

Not only are the incomplete notes incomplete, they are disorganized compared to the complete notes that are organized by categories such as speed in trees and weight. In the complete notes column in Figure 2, a category is identified for each fact. For example, the category *Speed in trees* is identified and then the speed of an orangutan is recorded as 15 mph, unlike the notes in the incomplete column that list the number 15 mph without identifying that it is the speed of orangutans in trees.

Organize. With a complete set of notes, the student could create a graphic organizer to display the main ideas similar to that in Figure 3. The Figure 3 matrix is better than the Figure 1 outline because it organizes category information such as the apes'

Incomplete notes	Complete notes
Gibbons 35 mile per hour swinging in trees. 20 pounds omnivores **Orangutans** 200 pounds 15 mph omnivores **Gorillas** are 6 feet weight 300 pounds 10 herbivores	**Gibbons** Speed in trees • 35 mph Weight 20lbs Height: • 2 feet Diet • Omnivores Defense: • Brachiate away Habitat • Live in trees Unique facts • Cannot swim, • Dexterous in trees **Orangutans** Speed in trees • 15 mph Weight • 200 lbs Height: • 5 ft Diet • Omnivores Defense: • Make loud noises in groups Habitat • Ground Unique facts • Name means man of the forest • Group cares for their young **Gorillas** Speed in trees • 10 mph Weight • 300 lbs Height: • 6 feet tall Diet • Herbivores Defense: • Gather in groups Habitat • Ground Unique facts • Least aggressive ape • Males are called silverbacks

Figure 2. Incomplete vs. complete notes example.

	Gorillas	Orangutan	Gibbons
Weight (lbs.)	300	200	20
Height (ft.)	6	5	2
Speed in trees (mph)	10	15	35
Diet	Herbivores	Omnivores	Omnivores
Defense	Gather in groups	Loud noises in groups	Brachiate away
Habitat	Ground	Ground	Trees
Unique facts	Least aggressive ape	Name means man of the forest	Cannot swim
Unique facts	Males called silverbacks	Group cares for the young	Dexterous moving in trees

Figure 3. Summary of notes.

speed and weight in two single rows. The outline in Figure 1 spreads the apes' weight and speed across six locations. Localizing of information is better because it helps students make associations. This graphic organizer summarizes text notes from the graphic organizer.

Associate. With information organized in a table, notes are no longer presented in a linear and disjointed fashion, and the student can easily identify meaningful relationships among the details. Examining Figure 3, the student can quickly identify the relationship between apes' weight and speed in trees by looking across Rows 2 and 4. It is clear that *the heavier the ape, the slower its speed in trees*. By scanning the table, other relationships are apparent:

- The shorter the ape, the faster its speed in trees.
- All apes weigh between 20 and 200 lbs.
- Two of the three apes are omnivores.
- One of the three apes lives in trees.
- The heavier the ape, the taller it is.

Grouping information in an economical manner makes learning associations easier.

Regulate. In this step, the student employs metacognitive strategies to regulate learning by creating practice test questions. For example, the student using Figure 3 about apes could create the following practice test questions:

- What is the average height of a gorilla?
- Which apes care for their young as a group?
- What is the relationship between apes' height and their speed in trees?

By generating test questions, the student can check understanding of the material and regulate learning.

Summary. By using SOAR, the student creates complete and effective study materials to review for the test. The materials contain a complete set of organized notes, a graphic organizer that presents the 24 facts at once, a set of associations across the three apes, and practice test questions.

Although the scenario mentioned above is hypothetical, the benefits of using the SOAR study strategy for learning are not. Jairam and Kiewra (2009) investigated the effects of SOAR for learning from text and found that students who use SOAR learn more facts and relationships than students who use their own study strategies. In addition,

Jairam and Kiewra (2010) examined the impact of SOAR for learning from computer-based materials and found that SOAR-trained students outperform students who follow their preferred study strategies. In both studies, however, just a single text was used. The benefit of SOAR for learning from multiple online resources is yet to be investigated. Doing so is important because it is well established in the literature that college students rely on *Internet* resources when preparing for exams (Dilevko & Gottlieb, 2002; Metzger, Flanagin, & Zwarun, 2003; Rieh & Hilligoss, 2008; Selwyn, 2008).

Given that SOAR has proved effective for learning from single text presented via computer (Jairam & Kiewra, 2009, 2010), it is possible that the SOAR study strategy could prove effective when learning text from multiple online resources. The present study addressed this gap in the literature. Specifically, it investigated the effects of SOAR for learning facts, relationships, and concepts from multiple online resources. The next section overviews the present study in more detail.

Present Study

This section includes the present study's purpose, research questions and predictions, and basic methodology.

Purpose of Study. The purpose of this dissertation was to explore the impact of a study strategy on students' learning from online resources. Specifically, this study investigated the effects of the SOAR study strategy on college students' learning of facts, relationships, and concepts when learning from multiple online resources as well as the quality and completeness of the study materials generated.

Research Questions and Predictions. The focus of this study leads to the following two quantitative research questions. First, *does SOAR impact students' achievement as measured by performance on fact, concept, and relationship items when learning from multiple online resources?* It is common to measure learning by testing students' learning of facts, understanding of concepts, and their ability to identify relationships. Huitt, Hummel, and Kaeck (2001) classified these three factors as scientific knowledge. The second quantitative research question was *does SOAR impact the completeness and quality of students' generated study materials with respect to selection, organization, association, and regulation of information when learning from multiple online resources?*

It was predicted that when students study using SOAR, they would outperform students using their preferred study strategies on learning of facts, relationships, and concepts when studying from multiple online resources. In addition, it was predicted that students using the SOAR study strategy would create quality study materials that demonstrate effective study strategies including a complete set of notes, graphic organizers displaying information, evidence of association among ideas, and practice test questions that regulate learning, whereas students using their preferred study strategies would demonstrate use of ineffective study strategies such as piecemeal learning, linear organization, and repetition.

The focus of this study leads to the following two qualitative research questions. First, *what study strategies do untrained students use when learning from multiple online resources?* It was predicted that untrained students would employ the same ineffective

study strategies when learning from multiple online resources as they have previously demonstrated (Baker & Lombardi, 1985; Erik Timmerman & Kruepke, 2006; Jairam, 2009; Jairam & Kiewra, 2009, 2010; Kiewra, 1985a; King, 1989; Locke, 2012). Second, *what are students' attitudes towards using the study strategies presented in the experiment when learning from multiple online resources?* It was predicted that students in the experimental group would find the SOAR study strategies easy to use, effective, and enjoyable. In addition, it was predicted that students in the control group would find their preferred study strategies unsuitable when learning from multiple online resources.

Methodology. In order to investigate how SOAR impacts students' performance on fact, relationship, and concept items, the present study followed a sequential two-phase mixed methods approach. First, students were asked how they study from multiple online resources, then they were divided randomly into two groups and trained to use their preferred study strategies or SOAR. Following training, students were tested on fact, relationship, and concept items. After testing, students were asked to report on the strategies they used to learn from multiple online resources in the experiment. Finally, follow-up interviews were conducted to gain insight into the strategies used in both groups and to better explain the quantitative results.

Chapter Two

Literature Review

This chapter is divided into four main sections. The first section discusses the ineffective study strategies that students use to learn, why these strategies do not work, and how they strategies may have developed. The second section discusses how SOAR addresses the ineffective strategies that students use and the research supporting each SOAR component. The third section discusses previous research on SOAR. The fourth section discusses the theoretical foundations of SOAR as a theoretical framework for this study. The chapter ends with a summary of the literature review.

Students' Ineffective Study Strategies

This section discusses the ineffective study strategies that students use to learn and provides an explanation for why these study strategies impair learning from a cognitive psychology point of view.

What are the ineffective strategies that students use? And why are they not effective? Researchers identify four main areas of students' weak study strategies (a) recording incomplete notes, (b) disorganized ideas, (c) learning in a piecemeal fashion, and (d) employing redundant strategies (Aharony, 2006; Jairam & Kiewra, 2009; Kiewra, 1985b; Rachal et al., 2007). This section discusses each ineffective strategy reported in the literature and the reasons why these strategies do not work.

Students create incomplete notes. Students struggle with taking notes in a lecture (Kiewra, 1985a), from text (Jairam & Kiewra, 2009; Kiewra, DuBois, Christensen, Kim, & Lindberg, 1989), and on a computer (Jairam & Kiewra, 2010) for later review. Often,

students have difficulties identifying key points (Mayer, 1984). Although they understand the importance of taking notes, they are poor note takers (Armbruster, 2000; Austin, Lee, & Carr, 2004; Lynch, 2007) who tend to omit 70% of critical information (Kiewra, 1985b; Titsworth, 2004). In part, this is because students are not instructed in how to best take notes (Baker & Brown, 1984). Furthermore, classroom environments do not consistently prompt behaviors necessary to produce a complete and accurate set of notes (Austin et al., 2004).

It is important that students create complete notes because studying from a complete set of notes is positively correlated with achievement and aids learning (Baker & Lombardi, 1985; Bauer & Koedinger, 2007; Carrier & Titus, 1979; Crawford, 1925; Di Vesta & Gray, 1973; Jairam & Kiewra, 2010; Kiewra & Benton, 1988; Locke, 2012; Piolat, Olive, & Kellogg, 2005). Moreover, a complete set of notes is important because when students take a test, they can only recall about 5% of non-noted information (Howe, 1970).

Reasons for why creating incomplete notes hinders learning and performance stems from the cognitive psychology concept of active processing. Students' incomplete note-taking fails to engage the active cognitive learning process of attention (Jairam & Kiewra, 2009; Kiewra, 2004). Students must purposefully devote conscious attention to selecting ideas they deem important. Devoting conscious attention has a strong influence on learning (Kruschke, 2005).

Students' study materials are disorganized. Students prepare for tests by studying from the notes that they take. However, they struggle with organizing their notes.

Rachel et al. (2007) surveyed around 500 students and reported that the majority of students have difficulties organizing information in their study materials.

Often, the notes that students create present information sequentially in a linear fashion in lists or paragraphs and lack meaningful organization (Kiewra, 2004). The predicament of learning from linear notes is the difficulty for students to compare and contrast ideas, develop meaningful relationships between topics, and associate ideas across several texts (Kiewra et al., 1996). For example, an outline about eagles and birds would separate habitat information about each bird making it difficult to identify mountain birds across the different birds, and obscure the relationship that larger birds live longer.

Cognitive load provides one explanation for why disorganized study materials impair learning. Cognitive load refers to how cognitive resources are used during instructional tasks. In particular, extraneous cognitive load is generated by the manner in which information is presented (Sweller, 1988). In terms of organization, students do not create graphic organizers combining their notes. Instead they create a list of notes in a linear form. Presenting notes in a linear form causes more extraneous cognitive load than using a graphic organizer like a table or matrix because learners use their limited working memory capacitates to search relationships from different locations that would otherwise be apparent in an organizer (Crooks, White, & Barnard, 2007).

In addition, by recording notes in linear form students do not engage in the cognitive process of storage. They separate ideas making it difficult to recognize

relationships across topics instead of organizing information in meaningful ways using matrices (Ormrod, 2006).

Students fail to associate ideas and rely on piecemeal learning. Students separate facts and attempt to learn one piece of information at a time. They fail to associate related ideas (Jairam, 2009; Jairam & Kiewra, 2009). For example, using a piecemeal approach to learning a student can memorize the individual weight of three birds and the average lifespan of each; yet fail to ascertain the relationship between a birds' size and its lifespan. Similar to studying from incomplete notes, piecemeal learning is associated with poor test performance (King, 1989).

Learning is impaired and extraneous cognitive load is imposed when students rely on piecemeal learning (Schüler, Scheiter, & van Genuchten, 2011). Working memory capacity is limited to three to four items at a time (Dempere-Marco, Melcher, & Deco, 2012). Therefore, when students learn one piece of information at a time instead of learning information in chunks, cognitive resources are expended and extraneous cognitive load is imposed (Sweller & Chandler, 1991).

Students fail to regulate their learning and rely on redundant study strategies. Often, students rely on repetitive study strategies such as reciting, rewriting, and recopying information (Weinstein & Mayer, 1986). Over half of students do not regulate their learning and rely on redundant strategies such as rehearsal (Gubbels, 1999). In fact, when students determine that they do not understand the material, they do not alter their study methods but rather engage in the same ineffective and redundant strategies (Gubbels, 1999). These strategies are ineffective (Kiewra & DuBois, 1997) especially

when combined with incomplete notes and disorganized study materials (Rachal et al., 2007). It is important that students regulate their learning because regulation is positively correlated with achievement (Gubbels, 1999).

Redundant learning strategies such as rehearsal are ineffective because they impose extraneous cognitive load. Learners expend their cognitive resources as they repeatedly process information (Sweller & Chandler, 1991). In addition, rehearsal strategies prevent students from actively engaging in metacognition strategies. They fail to check their learning and take no corrective action when they do not understand material or determine that they are confused (Gubbels, 1999).

Why do students use these ineffective strategies? Although 84% of college instructors believe that college freshman are underprepared or ill prepared to pursue a college degree (Sanoff, 2006), less than 10% of instructional time is spent teaching students effective study strategies (Durkin, 1978; Zimmerman, Bonner, & Kovach, 1996). Students are presented with content information without being taught how to learn. They are not introduced to study strategies that address their specific learning needs when learning from lectures, printed texts, or computer-based materials (Jairam & Kiewra, 2010; Rachal et al., 2007). In fact, college students from 118 four-year institutions reported that only 17% of their college instructors provided them with assistance to improve their learning (Saenz & Barrera, 2007).

College instructors report that they do not teach students study skills because they need to spend class time teaching required course content, they are not up-to-date with best and current teaching and studying practices in higher education (Wall, Macaulay,

Tait, Entwistle, & Entwistle, 1991), and they expect students to be ready to learn and understand the study strategies needed to succeed and excel in their subject matters (Boylan, 2002; Conley, 2007). Moreover, only a few instructors believe they are able to give instructional advice to their students (Tait & Entwistle, 1996). This does not come as a surprise because most college instructors' themselves were not taught how to learn (Strom-Gottfried & Dunlap, 2004). In summary, educators rarely show students how to study although they emphasize the importance of studying to their students.

In addition, college students are often guided to use ineffective study strategies. Rachel and colleagues (2007) report that students are taught skills or methods that do not include strong research-based strategies like creating complete notes, organizing information, relating information, or assessing their learning. In some cases, students are introduced to study methods that are difficult to use (Flippo & Caverly, 2008).

How Can SOAR Help?

It is apparent from the literature that students are in dire need of study behavior reformation. The SOAR study strategy has been proposed as a way to provide students with strategies that improve learning (Jairam, 2009; Jairam & Kiewra, 2009, 2010; Jairam, Kiewra, Rogers-Kasson, Patterson-Hazley, & Marxhausen, 2013). The SOAR study strategy aligns with cognitive views of learning because it incorporates four major learning processes: attention, storage, encoding, and metacognition. Figure 4 shows four ineffective study strategies that students follow, the SOAR component that addresses it, the cognitive process SOAR aids, and the effective strategy as a result of using SOAR.

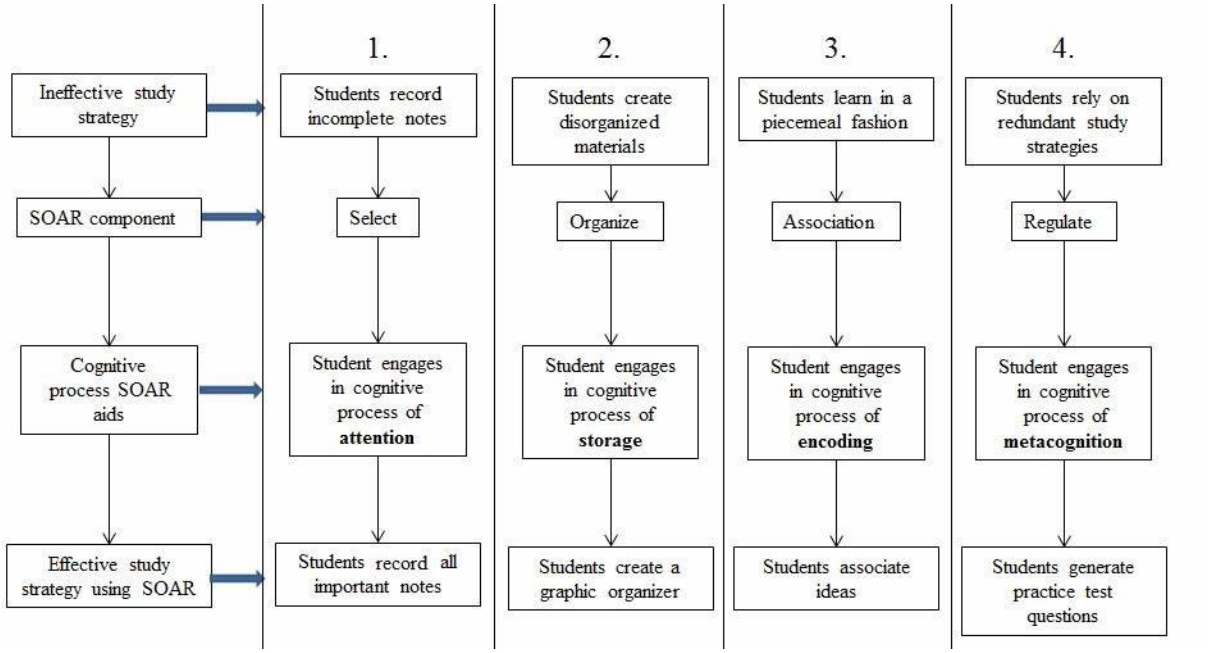


Figure 4. Ineffective study strategies, SOAR components, cognitive processes, and effective strategies.

The links between the four major learning processes and the four SOAR components are discussed next.

Select. In this step, students engage in the cognitive process of attention by carefully selecting information and converting it into notes. Select increases students' attention allowing learners to decide which information is discarded (stimuli learners ignore) and which information is processed (stimuli learners attend to) and sent to short-term memory (Broadbent, 1958; Cowan, 1988; Mayer, 1984). Select can help students create a complete set of notes containing all of the important ideas. Taking notes increases attention and results in improved achievement (Baker & Lombardi, 1985; Kiewra, 1985b).

The source of information can alter the selection process. For example, taking notes from a lecture versus taking notes from text can alter students' ability to select. In lectures, students are required to listen to a lecturer who speaks at an average of two to three words per second, while simultaneously writing at an average of 0.2 words per second (Piolat et al., 2005). This discrepancy affects the quality of notes, divides students' attention, and ultimately stands in the way of learning (Iidaka, Anderson, Kapur, Cabez, & Craik, 2000; Kiewra, 1985b; Piolat et al., 2005). In addition, students have difficulties taking notes from a computer. They often engage in ineffective note-taking strategies like highlighting, typing incomplete notes, and copying-and-pasting verbatim chunks of text (Igo, Bruning, & McCrudden, 2005; Igo, Kiewra, & Bruning, 2008).

SOAR assists students in creating complete notes containing all important information and ideas. In select, students give attention to critical information and thus record complete notes.

Organize. In this step, students engage in the cognitive process of storage. Students are encouraged to create a graphic organizer to summarize the ideas from their notes. Selecting information does not guarantee storage in long term memory. In order to optimize information storage, students need to *organize* information in graphical organizers so that associations within the material become apparent (Jairam and Kiewra, 2009).

Kiewra (2004) describes four main types of graphical organizers as: sequences, matrices, illustrations, and hierarchies. Using a graphic organizer allows information to be presented efficiently in comparison to linear notes and outlines. For example, matrices

localize information allowing students to quickly derive logical conclusions from representations (Kiewra, 2004).

Researchers have explored the relationship between graphic organizers and learning (Ausubel, 1963; Barnes & Clawson, 1975; Barron, 1979; Lawton & Wanska, 1977; Mayer, 1978, 1979; Meyer & Freedle, 1984; Reder, 1980). Mayer (1979) conducted nine experimental studies on the use of organizers and found that when necessary, the reorganization of information into organizers aided recall performance.

Parallel findings were found in a study by Ausubel (1963). Findings showed that advance organizers help stimulate prior knowledge and encourage encoding. Similarly, Alvermann (1981) conducted a study to clarify conditions under which graphic organizers can be used to facilitate comprehension and retention of expository prose. This study further reinforced Mayer's (1979) findings that the reorganization of information into organizers aided recall performance when reorganization was necessary.

Researchers discussed how to optimize learning using advanced organizers. Stull and Mayer (2007) recommend providing students with pre-identified organizers, rather than having students create their own. They reported that students who created their own organizers might have experienced extraneous cognitive load.

SOAR aids organization as students create organizers to summarize their notes, and thus improve their learning.

Associate. Association in SOAR relates to linking new information to each other (internal) and with information already stored in long term memory (external), this learning process is known as encoding. Mayer (1996) refers to association as integration.

Mayer (1996) identified two types of association: internal and external. Internal associations refer to relationships among presented ideas. These associations are made within the content of the study material. External associations refer to relationships among newly presented information and existing knowledge in memory. These associations are made between the content material being learned in working memory and prior knowledge already stored in long-term memory. Association has also been identified in the literature as generative learning (Wittrock, 1989) and elaboration (J. Anderson, 2000).

The SOAR method aids encoding by helping students build associations. After students have organized information using graphic organizers, they are encouraged to review the facts in the organizer vertically to expose associations within a column and horizontally to expose associations in a row (local) and across multiple columns and rows (global) (Jairam and Kiewra, 2009). Identifying associations assists students in learning and discourages piecemeal approaches to learning (King, 1991)

Students that identify relationships from graphic organizers achieve more than their peers that study from liner notes (Moreland, Dansereau, & Chmielewski, 1997). In the association step of SOAR, students are asked to relate new facts to each other within the content material to be learned and to information that they already know.

Regulate. The regulate component of SOAR relates to metacognition, awareness, and understanding. Metacognition is defined as "the awareness of and knowledge about one's own thinking" (Zimmerman et al., 1996, p. 65). Research suggests that reaching metacognition can be achieved by generating potential questions about the content to be

learned (Baker & Brown, 1984; King, 1989; Wadsworth, Husman, Duggan, & Pennington, 2007; Weinstein & Mayer, 1986). The literature reports that students who generate practice questions demonstrate higher performance than students that do not (Baker & Brown, 1984; Duell, 1977; Foos, Mora, & Tkacz, 1994; Frase & Schwartz, 1975; King, 1989). Generating practice questions provides students with the opportunity to self-check their learning and enhance it (Karpicke, Butler, & Roediger, 2009).

Students who use SOAR, regulate learning using summarization and question generation. Kiewra (2004) identified three types of learning. First, facts that require students to know a single fact such as *the most populated country in the world is China* or relationships that require students to know relationships between two or more facts such as *China exports more items per year than Germany*. The second type of learning is concept learning which requires students to identify new examples. For example if students were told: *all wildcats hunt at night but the Cheetah*, then a possible concept question might be *If you were out during the day on a safari in Africa, what wildcat are you not likely to see?* The third type is skill learning that requires students to apply a procedure or learned rules. Skill questions also require the student to apply information. For example, students might learn that psittacosis is a disease commonly found in parrots (fact) and recognize the diseases' symptoms (concept) but not be able to treat it (skill). SOAR assists students in generating practice questions that address the three knowledge types.

Research Support of SOAR

SOAR has been investigated with learning from text and on a computer. An overview of these three key studies is provided next.

Jairam and Kiewra (2009) tested the integrated SOAR method for fact and relationship learning by comparing students who study using SOAR and students who study using their preferred study strategies when learning from text. They also examined the effects of the SOAR components separately. Sixty students participated in the experiment and were assigned to one of four treatment groups: control, Selection (S), Selection/Organization (SO), Selection/Organization/Association (SOA), or the complete SOAR components Selection/Organization/Association/Regulation (SOAR).

Each group was provided with instructor-generated study materials on the topic of wildcats. The control group studied using their preferred study strategies. The Selection (S) group studied a complete set of notes, containing 78 facts laid out in a linear, outline format typed on 6 pages. Selection/Organization (SO) group studied a complete set of notes containing 78 facts laid out in a two-dimensional matrix format printed horizontally on a single page. Facts were organized across 13 categories to allow for comparison (i.e., genus, call, weight, and so forth). The Selection/Organization/Association (SOA) group studied the wildcat matrix plus a list of 27 wildcat associations. The Selection/Organization/Association/Regulation (SOAR) group studied the matrix and associations plus practice tests with provided answers to regulate learning.

All groups took two tests assessing fact and relationship learning. In the fact test, students were asked to recall facts from the text on wildcats. In the relationship test,

students answered open-ended relationship questions. For facts, studying from a matrix organizer produced higher achievement than studying the text on its own, the matrix plus associations, or the matrix plus associations and practice test questions. For relationships, the SOAR group learned more relationships than all other groups but the SO group. SOAR studies outperformed the control group by 81% to 40% on the relationship test and 80% to 76% on the fact test.

In the second study, Jairam and Kiewra (2010) tested SOAR in a computer-based learning environment using two experiments. In the first experiment, 114 undergraduate students were surveyed about the study strategies used for computer-based learning. The ineffective and effective strategies were organized according to SOAR components. Students were asked to rate how often they use the following ineffective strategies on a scale of 0 to 10: (a) highlighting (selection), (b) creating lists and outlines (organization), (c) focusing on learning single facts (association), (d) rereading, and (e) recopying (regulation). The effective strategies included (f) note taking by typing or by (g) copying and pasting (selection), (h) creating charts (organization), (i) relating newly presented ideas with each other or (j) with prior knowledge (association), and (k) creating practice questions, and (l) summarizing (regulation). The students reported that they generally use ineffective strategies about 70% of the time.

In the second experiment, 108 and undergraduate students were assigned randomly to the control group or one of four experimental groups. Each group was presented with a different set of study materials on the topic of wildcats. The control group studied an online text using their preferred study strategies. The four experimental

groups used one or more SOAR study strategies and were helped to create their study materials. The four groups were select (S) that studied 78 facts displayed on the left side of a computer screen. The right side of the screen displayed a note-taking framework listing 13 categories that covered the topic of wildcats. When a fact was clicked on the left side of the screen, it appeared on the right side of the screen beneath the category it belonged to.

The select/organize (SO) group were provided with the full wildcat text on the top part of the screen and 13 categories in a blank matrix organizer on the bottom part of the screen. When students clicked a bracketed fact from the screens' top section, it appeared in the appropriate matrix cell in the screens bottom section.

The select/organize/associate (SOA) group were given identical material as the SO group plus association material. The left side of the screen displayed the matrix that students completed. Only after the matrix was complete, the right side of the screen displayed 14 clickable buttons. When students clicked an association button, a text box appeared under the matrix containing an association and the cells in the matrix relative to the association were highlighted on the screen.

The select/organize/associate/regulate (SOAR) group was given identical material to the SOA group plus 44 practice test questions. Two sets of practice questions appeared: fact questions and then relationship questions. The practice fact and relationship questions were similar to those on the final tests but were not identical. Thirty fact question buttons appeared on the right side of the screen. When students clicked on one of the practice test question buttons, an empty matrix appeared with a

multiple choice fact practice question below it. Clicking the correct choice highlighted the correct answer and displayed it in its corresponding matrix cell. The materials also contained 14 relationship questions that appeared after students completed fact questions. Similar to what they did for fact questions, students clicked on a relationship question button and the matrix would highlight the relative information.

Students were tested on their learning of facts and relationships. Both tests were administered online. The relationship test contained 14 open-ended questions and the fact test contained 30 multiple choice questions. Findings showed that the means for fact test performance increased across groups linearly as students used their preferred study strategies to an increasing number of SOAR strategies. As students used more SOAR components their performance on the fact test was higher. Similar findings occurred for the relationship test. The means for relationship test performance increased across groups linearly as students used their preferred study strategies to an increasing number of SOAR strategies.

In the third study, Jairam and colleagues (2013) compared the study strategies SQ3R and SOAR to determine if one is more effective than the other. Twenty five (25) college students were trained for 30 minutes in the SQ3R or SOAR strategy and then asked to study a long text passage about reinforcement schedules. The text covered 4 reinforcement schedule types that included information pertaining to reinforcement delivery, example, and response rate and pattern. Students were provided with instructor-generated SQ3R or SOAR study materials, respectively. Then, students were assessed on fact, relationship, and concept learning in achievement tests including 30 multiple choice

items each with 4 choices. Results confirmed that students who used the SOAR system outperformed those who used the SQ3R system and learned 20% more relationships, 14% more facts, and 13% more concepts.

The first two studies show that students who used SOAR scored higher on fact and relationship tests than students who used their preferred study strategies when learning from text and computer-based materials (Jairam & Kiewra, 2009, 2010). The more SOAR components students used, the higher their performance on relationship and fact tests. The third study shows that students who use SOAR outperformed those who used SQ3R on concept, relationship, and fact learning (Jairam et al., 2013).

The present study is unique in two ways. First, in previous studies on SOAR, students studied from one comparative text presented to them on computer or paper (Jairam & Kiewra, 2009, 2010). In the present study, students studied from multiple online resources. Second, in previous studies, students in the SOAR group were provided with a complete set of instructor-generated notes (Jairam & Kiewra, 2009; Jairam et al., 2013) or were assisted in creating their study materials following guided examples and feedback (Jairam & Kiewra, 2010). However, in the present study, students in the SOAR group were trained on SOAR and then relied on their training to create study materials in preparation for the test without assistance.

Information processing serves as the theoretical framework for the present study. The next section addresses the theoretical background of SOAR.

Theoretical Background

The theoretical roots of the SOAR study strategy can be drawn from a blend of information processing and cognitive constructivism. This section discusses both psychology perspectives and how SOAR aligns with modern cognitive psychology views.

Information processing refers to how information is processed in human memory, organized for storage and retrieved for later review (Eggen & Kauchak, 2007). Information processing can be explained by the three-component model of memory. Ormrod (2006) suggested that an acceptable and valid way to explain how human memory works is through the three component model of memory. This model explains the process of information first being received in working memory; only after conscious attention can it be transferred to long term memory through encoding. This view point of human learning has been thoroughly addressed (J. R. Anderson, 2009; Eggen & Kauchak, 2012; Sternberg, 1985)

With regard to cognitive constructivism views on learning, students do not learn when receiving information passively, rather they must take an active role in learning (Ormrod, 2006). Mayer (1996) explains the primary difference between students who assume an active role in learning and those who processes information and create own knowledge. In constructivism, learners construct mental representations of information in ways that are sensible to them (Jairam, 2009). Therefore, new learning is dependent upon the learner's unique prior knowledge (Eggen & Kauchak, 2007).

Modern cognitive psychology views combine information processing with cognitive constructivism (Mayer, 1996). In this view, learners are required to engage in

active cognitive processes such as attention, storage, encoding, and metacognition as information is processed in sensory, working, and long-term memory (Eggen & Kauchak, 2007). First, learners' attention is increased as they select information for further processing. Next, information is stored and recalled in an organized fashion (Ormrod, 2006). Then, metacognitive processes that encourage learners to check their understanding of content are used to transfer information from long-term memory back to working memory.

Kiewra (2004) developed SOAR based on Mayer's (1996) SOI study system that includes the steps of selection, organization, and integration. Kiewra (2004), further extended Mayer's theory to include the process of regulate. SOAR is closely aligned with modern cognitive psychology views of learning because it encompasses both information processing and cognitive processes in its study strategies. Students *select* important pieces of information. Information is sent to working memory; this supports the cognitive process of attention. Next, students create organizers to *organize* their notes. This process relates to storage. The process of organizing notes supports storage of information. Then, encoding occurs when students *associate* information within the content and with prior knowledge. At this stage, information is sent to long-term memory. Last, students *regulate* information by generating potential test questions. When students generate a list of question, metacognition occurs.

Summary of Literature Review

College students lack the necessary study skills to successfully learn from text (Jairam & Kiewra, 2009) and computer based materials (Jairam & Kiewra, 2010). They

often use ineffective study strategies when learning. Research identifies four main ineffective study strategies that hinder students' learning: (a) recording incomplete notes, (b) disorganized ideas, (c) learning in a piecemeal fashion, and (d) employing redundant strategies (Aharony, 2006; Gubbels, 1999; Jairam & Kiewra, 2009; Kiewra, 1985b; Rachal et al., 2007).

Kiewra's (2004) SOAR study strategy addresses the four main weak strategies that students use. SOAR consists of four strategies for effective learning: (a) selecting important information and creating complete notes, (b) organizing ideas using graphic organizers, (c) associating ideas within and across topics, and (d) regulating learning by generating practice test questions.

The literature review shows that each SOAR component engages students in a cognitive process essential to learning. Furthermore, research shows that each SOAR component is well supported as an effective study strategy.

SOAR has proven effective with printed text and online prose materials (Jairam & Kiewra, 2009, 2010). However, students today must know how to learn from multiple online resources. Subsequently, it is important to investigate how to best prepare students for learning from multiple online resources. The present study examines the effect of using SOAR to learn from multiple online resources.

Chapter Three

Research Method

The present study follows an explanatory sequential mixed methods design. This research design occurs in two sequentially distinct interactive phases, a quantitative phase that begins with the collection and analysis of quantitative data followed by the subsequent collection and analysis of qualitative data (Creswell & Plano Clark, 2011). The qualitative phase follows from the results of the quantitative phase.

The first phase involves a quantitative phase that follows a true experimental design to establish a cause and effect relationship between the use of the SOAR study strategy for learning from multiple online resources and achievement. Subsequently, the quantitative research design was used to establish cause and effect between the use of the SOAR study strategy and the quality of study materials created by the students' when learning from multiple online resource during the experiment.

The second phase of the experiment involved qualitative data gathering to explore study strategies that college students use when learning from multiple online resources and to provide insight into college students' attitudes towards the study strategies they used in the experiment. In this phase, students from the control and experimental groups participated in an online attitudinal survey to gauge their experiences. Students from both groups participated in a follow-up interview.

This research method chapter provides an overview of the research design with the aim of matching the design to the research problem, purpose, and questions. It specifies the participants, materials, procedures, and design used for data gathering and

data analysis. This chapter contains five sections: participants and design, materials, procedure, research variables, scoring and analysis.

Participants and Design

Participants. The target population was undergraduate students enrolled in an educational psychology course in the College of Education and Human Sciences at the University of Nebraska – Lincoln in the Fall semester of 2013. Approval to conduct this study was granted by the University's Institutional Review Board prior to data collection (IRB #20130413347 EX.).

Students were invited to participate from seven sections of the educational psychology course. These course sections are relevant to this study because of their enrollment numbers and their instructors' cooperation. In addition, the goal of the education intervention was relevant to the students participating, as it provides training that might assist them in studying from multiple online resources. The skills learned in the experiment could be applied in other courses.

One hundred-thirty four (134) undergraduate students participated in this study. Their average age was 20 years old, 57% were male, and 43% were female. The students were 6% freshman, 58% sophomores, 19% juniors, and 17% seniors. The study required a minimum of 78 students (see *Quantitative Sampling Procedure* section below). Participants were assigned randomly to the control or experimental group. Cohen (1988) recommends a minimum of 30 participants in each group when comparing the means. The sample size for comparing 2 groups was met in this experiment. The control group

(*N* = 63) followed their preferred study strategies, whereas the experimental group (*N* = 71) used the SOAR study strategy.

Sampling. The present research sampled students for the quantitative and qualitative phases of the research design. This section details the quantitative and qualitative sampling procedures.

Quantitative sampling procedure. Consistent with sampling procedures in educational research, a random sampling procedure was applied. A set of individuals participated who were equally eligible and willing to participate in the intervention. The students that participated in this study were given an equal and independent chance of being selected into either group using a table of random numbers.

To calculate the needed sample size for this experiment, the power analysis tool Gpower version 3.15 was used. Sample size was conducted on the basis of 1 independent variable (SOAR Treatment), 3 dependent variables (fact, concept, and relationship items) and 2 groups (control vs. experiment). Alpha level was set at ($\alpha = 0.05$, two tails) with a large effect size of ($d = 0.8$) and a reasonable power of (0.8). Gpower resulted in $N = 78$ required subjects. The actual sample size for this experiment ($N = 134$) exceeded the required number. Figure 5 represents the sample size analysis.

Qualitative sampling procedure. This study required a qualitative phase to further explain the quantitative results. It is recommended to use a smaller sample size for an in-depth analysis in the qualitative phase (Creswell, 2008; Creswell & Plano Clark, 2011; Tashakkori & Teddlie, 1998).

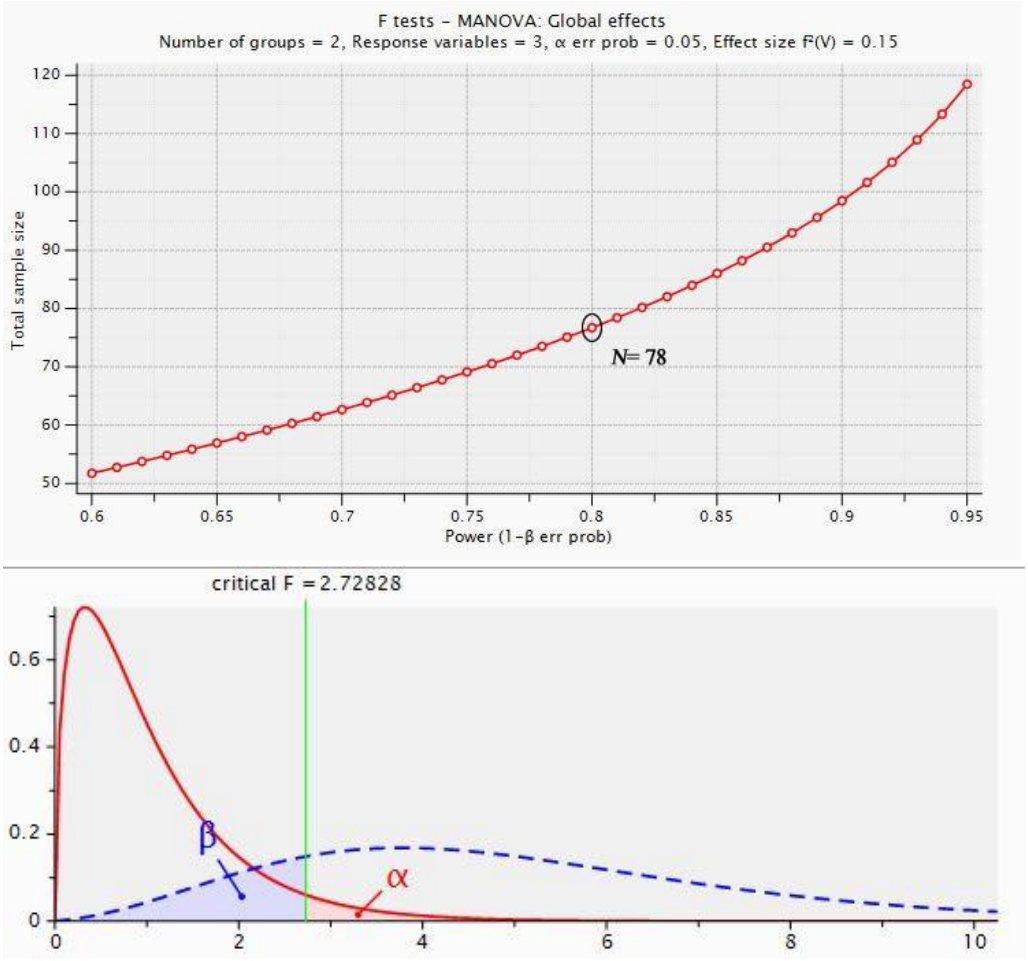


Figure 5. Sample size analysis graphic.

Three (3) samples were selected for the qualitative phase. First, students from both groups were asked about the steps they take when learning online in the pre-survey, therefore the first sample was 134 students. Second, 71 students from the experimental group were asked to select the most and least useful SOAR component and to explain why in the post-survey. These questions were related to the SOAR study strategy and therefore were not administered to the control group. Third, students who volunteered to participate in the follow-up interview formed the third qualitative sample. All students

were invited to participate, but only 15 students volunteered, 8 from the experimental group and 7 from the control group.

The qualitative purposeful sampling procedure was used to select participants for the follow-up interview as recommended by Creswell (2008) and Creswell and Plano Clark (2011). Specifically, qualitative sampling was used to select individuals from both groups to represent different perspectives. It is important that individuals have experienced the key concept being explored in the study (Creswell, 2008) and that they participated in the quantitative phase (Creswell & Plano Clark, 2011). A small sample size in the qualitative phase is expected when the focus of the study is quantitative oriented. A sufficient sample size is reached when meaningful themes can be developed (Creswell & Plano Clark, 2011). The 15 interviewees were sufficient to develop meaningful themes in this study.

Materials

Materials included: (a) apparatus; (b) pre-survey (Appendix A.); (c) training Materials (Appendices B.1 and B.2); (d) study materials (Appendices J, J.1, J.2, J.3, J.4 and J.5); (e) post-survey – experimental and control (Appendices E.1 and E.2); (f) follow-up interview protocol (Appendix F); and (g) Assessment Material (Appendices K.1 and K.2).

Apparatus. This experiment required the use of computers. It took place in a computer lab containing a total of 24 desktop computers. All computers used the Microsoft operating system Windows 7 with 19 inch flat screen monitors. Each computer contained an *Experiment* folder. The experiment folder consisted of two sub-folders, one

containing materials designed for the control group and the other containing materials designed for the experimental group. The files in each folder combined pages created with HTML, Javascript files, a CSS file, and images in JPEG format. Images were compressed and processed in accordance to the web multimedia guidelines recommended by Li and Drew (2004). Images displayed on the offline website were downloaded from royalty free websites.

A link to a Doodle registration form was sent to students via the LMS Blackboard. The registration form contained a full schedule of possible times and dates that students registered for. Students selected to attend one of the twenty-eight available time slots.

The Mozilla Firefox browser version 25.0 was used to display the pages on the website. The pre-survey, achievement test and post-survey were built using the Qualtrics online survey software. The offline website was developed using Adobe Dreamweaver 5 combining HTML, CSS, and JavaScript code.

JavaScript was used to develop preventative measures that control the navigation, timing, and flow of information on the screen. It also controlled user input on the pages. For example, users were not able to go back to a previous page by clicking on the browser's back button or by accessing the browser's history list. A *no back* function was added to all pages throughout the website. The script used was:

```
<SCRIPT type = "text/javascript">
window.history.forward();
function  noBack(){ window.history.forward(); }
</SCRIPT>
```

Each HTML page contained a *Refresh* function. This function made it possible to display information on computer screens for a predefined period of time. The HTML

code below is an example for one page that was displayed for 1 minute and 15 seconds: <meta HTTP-EQUIV = "REFRESH" content = "85; url = endcontrol.html">. The number “85” represents the amount of seconds that this page was displayed on the screen before it automatically displayed the next webpage. The “url” part of the code identifies the next page to display. The next page to be displayed on the screen is the *endcontrol.html* page.

Pre-survey. The pre-survey consisted of 8 questions located in Appendix A. Questions 1 through 7 gathered quantitative frequency data. Question 8 gathered qualitative data. Therefore, this instrument is both a qualitative and quantitative data gathering instrument.

Question 1 asked students to provide their 5 digit number (see *Procedures* section below for details). Questions 2, 3, and 4 gathered demographic information (sex, age range, and year of study). Question 5 asked students if they had participated in courses that taught the SOAR study strategy. These courses at the University of Nebraska-Lincoln are EDPS 855, EDPS 209, and EDPS 362. Question 6 asked students if they were familiar with the SOAR study strategy. If students answered “*Yes*,” then two sub-questions were administered. First, they were asked to explain how they became familiar with this study strategy in question 6.a. Then, they were asked to explain if they had used SOAR when learning online materials in question 6.b. Questions 5 and 6 were designed to eliminate participants with previous instruction in SOAR. The goal of these questions was to minimize bias in the study. This information was used to remove data in the analysis stage. No students were removed during the experiment phase.

Question 7 asked students if they were asked by their college instructors to independently use the Internet for the purpose of learning about a topic introduced in class. If they answered "*Yes*," then question 7.a was administered. It asked students if the instructor provided them with a study strategy to assist them when learning online.

Question 8 gathered qualitative data. It asked students to explain, in detail, the steps they follow when learning from multiple online resources. This question was asked to provide a better understanding of the study strategies that students use when learning online from multiple web resources.

Training materials. A website containing training material for each study method, SOAR or preferred study method, was developed. The training was adapted from a previous experiment by Jairam and Kiewra (2009). Training was timed to advance automatically from page-to-page and required an equal time of 30 minutes to complete for both groups. Students used their notepads to take notes during the training. Students were instructed to use the provided red pen when taking notes in the training phase and the provided blue pen for taking notes during the acquisition phase. Using a different color pen allowed the researcher to quickly identify notes taken in each phase.

The training materials for both groups contained three passages presented in the following order: Symbiosis, The study of Animal Behavior, and Wildcats. The Symbiosis passage defined the meaning of symbiosis and presented its three different types in 84 words (Appendix B.5). The Study of Animal Behavior passage described two types of psychologists and how they approach studying animal behavior in 116 words (Appendix B.6). The Wildcats passage described four types of wildcats: tiger, lion,

cheetah and bobcat in terms of physical features, life span, and life style in 505 words (Appendix B.7). The same texts were presented during training to both groups.

Although students from both groups were trained for an equal amount of time and studied the same three texts, the nature of the training was different in terms of the introduction, general instructions, and flow of information. Training material for the control group began with the introduction. The introduction informed students that they will be given three passages to study one at a time (Appendix L.1). They were told that they could take notes on the provided notepads using the red pen and that they will be asked to recall information from memory. Students were presented with the first passage on *Symbiosis* and were asked to study the passage using their preferred study strategies and take notes in their notepads using the red pen. Then they were instructed to open a new page in their notepad and try to recall as much information as possible and write it in their notepads. The same steps were repeated for the remaining two passages on animal behavior and wild cats.

Students in the experimental group were presented with a demonstration of SOAR's four steps: select, organize, associate, and regulate. Training material for the experimental group began with an introduction. The introduction informed students they were going to learn about a study method called SOAR, learn how to use the method, and be given the opportunity to practice it. Then, the training materials overviewed SOAR and its four steps. Next, participants were presented with the first passage on symbiosis with a demonstration on how to study the passage using the SOAR study strategy. Afterwards participants were presented with the second passage on animal behavior.

They practiced studying the passage using SOAR with ongoing feedback. Finally, students were presented with the third passage on wildcats and given the opportunity for uninterrupted practice with complete feedback on each SOAR component at the end.

Study materials. During the experiment, students studied five passages on five ape types: gibbons (Appendix J.1), orangutans (Appendix J.2), siamangs (Appendix J.3), gorillas (Appendix J.4), and chimpanzees (Appendix J.5). The texts were presented as hyperlinks on an offline webpage displaying the results of a search for the keywords *Superfamily Hominoidea*. Superfamily Hominodia is the biological family that all apes belong to.

The list of results page was designed to match a search engine's appearance, functionality, look, and feel. Each link presented on the results page contained a title (for example: Hylobatidae – Gibbons), a short hyperlink indicating its location on the web (for example: gibbonsinfosite.org/g-hylobatidae), and a brief two sentence description for that particular link (for example: The lesser apes family Hylobatidae, meaning "tree dweller" include the gibbon and siamang). Search engines typically pull these descriptions from the content available in a page's *header* HTML tag. In this study, the descriptions were added by the researcher from the results of online search using the same keywords, Superfamily Hominoidea.

Each of the five hyperlinks in the search results webpage linked to a webpage with information about one of the five apes. Each webpage contained at least one image of the ape and a passage covering the same ideas related to apes. These ideas included information on the ape's biological family heritage, physical characteristics, social

behaviors, life span, defense mechanisms, diet, range, swimming ability, unique attributes, and sleeping patterns. The order in which the ideas were displayed was different on each ape page.

The passages contained, on average, 280 words (see Appendices J.1 - J.5). A total of 103 idea units were represented in all five passages (see Table 14 in Appendix K.1). Facts about the apes were adapted from the National Primate Research Center (2011) at the University of Wisconsin – Madison.

Toward the bottom of each apes' webpage, a *back to search results* button was available. Students clicked on this button to navigate between the search results and the webpages for each ape.

Achievement test. The achievement test was used to gather quantitative data. It contained three types of items: (a) concept (5 items); (b) relationship (10 items); and (c) fact (10 items). The complete test is presented in Appendix D.

In the achievement test, the concept items section began with a scenario providing context for its questions (see Appendix D.2). The scenario presented to the students was "*A group of researchers, biology professors, and students from the University of Nebraska-Lincoln take a trip to learn about the world of apes. They travel to a different continent to visit a natural conservatory of apes. A biologist in charge of the conservatory offers to take them to explore the area*." The concept items were presented in five multiple choice questions with five different response options. The response options were either the five genera: hylobates, pongo, gorilla, pan, and homo, or the five apes: gorillas, chimpanzees, gibbons, orangutans, and siamangs.

The concept items were designed to examine students' ability to recognize the genus of an ape or the type of ape from a list of characteristics presented in the item. A sample item was "*They decide to take a break from hiking and they noticed an ape had captured two robins to eat. This medium sized ape carried one robin in each hand and walked away from them on both her legs. The ape they saw was from which genus:"* By recognizing identifying characteristics such as type of food (meat), the ape's size (medium), and the ability to walk on both legs, students can recognize that the ape was a chimpanzee.

The second section in the test presented ten relationship items. The relationship items section began with a definition of what relationships are (see Appendix D.3). The first five items asked local relationship questions. Local relationships in the ape texts were relationships that relate one idea to one or more ape. An example of a local relationship question was: How many of the apes were omnivores? In this question, the idea addressed was the apes' diet. The second five items asked global relationship questions. Global relationships in the ape texts relate two or more ideas to more than one ape. An example of a global relationship question was: What is the relationship between an ape's size and speed in trees? In this question, the two ideas are the ape's size and speed.

The third section in the test presented ten fact items. The items asked students to recall facts presented in the Apes material and select the correct response. Sample items were "Which ape belongs to the genus Pan?" and "Which male ape has a patch of silver hair on his back? The response options were either the five genera: hylobates, pongo,

gorilla, pan, and homo or the five apes: gorillas, chimpanzees, gibbons, orangutans, and siamangs.

The concept items were presented first because concept items require a form of transfer learning (Mayer, 2008). Presenting the concept items at the beginning prevented students from learning facts or relationships during the test and using that information to answer the concept items.

In creating these tests, I followed the recommendations of Creswell and Plano Clark (2011), DeVellis (1991) and the Handbook for Improving Test Construction Skills (2004) for establishing content validity, face validity, and internal consistency. The recommended steps followed were:

First, content validity was established. The items in the achievement test were reviewed by an expert to judge completeness, content, and sentence structure of the test instructions and items. Twenty-one (21) items of the exam were revised. Edits to wording, content, and sentence structure were recommended by the expert. Nine (9) relationship items were removed and replaced with 8 relationship items and 1 concept item.

Second, face validity was examined in two pilot tests. Face validity was obtained by asking seven graduate research assistants and four undergraduate students who participated in pilot tests to rate the validity of the test and to provide feedback on the questions and experiment design. Participants provided their feedback immediately after the test as recommended by Nevo (1985). The participants reported one item in the concept test that needed to be re-worded and believed the instructions provided for the

relationship items needed further clarification. As a result, the instructions were edited and the one concept item was reworded.

Third, after the experiment was completed the test was scored and the means, standard deviation, and variance were calculated for each item and inter-item correlations were calculated for internal consistency. Cronbach's alpha measure of internal consistency for the achievement test was 0.8.

Post-survey. A post-survey was created to assess students' attitudes towards the study strategies used in the training and acquisition phases of the experiment (see Appendices E.1 and E.2). The control group post-survey contained four questions. The experimental group post-survey contained seven questions. Questions 1, 2.a – 2.g, and 3 were the same for both groups.

Students from both groups were asked to rate their attitudes in Question 2 between "0" and "10" by moving sliding a bar on the screen, where "0" was "Strongly Disagree" and "10" was "Strongly Agree." Questions 2.a, 2.b, and 2.c asked students to rate the study methods they practiced in the training phase on ease of use, effectiveness, and enjoyment. Questions 2.d and 2.e asked students to rate the study methods they used in training for learning the Ape material on effectiveness and enjoyment. Questions 2.f and 2.g asked students to rate the study methods for future learning of content and future learning from online resources.

Question 3 was an open-ended question that gathered qualitative data. Students from both groups were asked to describe in a step-by-step fashion how they studied the material on Apes.

In the control group post-survey, Question 4 was a Yes/No question that asked students if they were interested in learning about a study method that would assist them in learning from multiple online resources.

In the experimental group post-survey, Question 4 is a multiple choice question that asked students their opinion on the most useful SOAR component. They were only allowed to select one. Question 5, was an open-ended question that gathered qualitative data. It asked students to explain their reasons for selecting the most useful SOAR component. Question 6 was a multiple choice question that asked students their opinion on the least useful SOAR component. Students were only allowed to select one. Question 7, was an open ended question that gathered qualitative data. It asked students why the component they selected was the least useful one.

The survey was created following the guidelines recommended by Hinkin (1995) and Nunnally (2010). The number of items in the post survey were kept short to obtain content and construct validity (Cronbach & Meehl, 1955). The scale used in Questions 2.a – 2.h generates sufficient variance among respondents. The response option ranged from 0 to 10. This range is recommended for subsequent statistical analysis (Hinkin, 1995). In terms of reliability, scales reach their optimal reliability at 11 (Nunnally, 2010). The scale in this experiment tops out at 10. For example, Question 2.d asks:

The study methods used during the training were effective when learning the Ape material:

0 1 2 3 4 5 6 7 8 9 10

Interview protocol (IP). A follow-up interview was conducted to provide a broader understanding of the study strategies that college students use when learning from multiple online resources and to provide insight into students' attitudes toward using the study strategies presented to them during the training phase for learning from multiple online resources during the acquisition phase.

The IP contained ten questions (see Appendix F). It was developed according to the recommendations of Creswell (2008) with clarifying and elaborating probes to elicit more information. Question 1 asked students to explain how much effort they put into the activity in general and in training and acquisition phases. Two probes followed. First, students were asked if they believe their performance would have been better if they would have put forth more effort and to explain their reasons. Second, experimental group participants were asked if they believed their performance would have been the same, better, or worse if they would have not followed the steps in SOAR and to explain their reasons.

Question 2 asked students from both groups to describe how they learn online. Question 3 asked students from both groups to describe their study strategy when learning from multiple online resources. Question 4 asked students from both groups to describe how they learned the steps that they followed when learning from multiple online resources. Question 5 asked students from both groups to describe the steps they followed when learning the material on Apes.

Questions 6 to 10 were designed to gather the experimental group's opinions on the experiment. Question 6 asked students to describe how useful or disadvantageous the

SOAR method was in helping them learn. Question 7 asked students to describe what they thought SOAR helped them accomplish. Question 8 asked students to describe how SOAR makes them think about the process of taking notes from online resources. Question 9 asked students to describe which component was most useful and which component was least useful and to explain their reasons. Question 10 asked students to describe how likely they were to use the SOAR study strategy when learning from multiple online resources and why.

The content validity method was used to validate the instrument following recommendations of Haynes, Richard, and Kubany (1995). The domain and construct of the interview protocol were defined and subject to the review of two experts. Then, items were developed and each item was reviewed by experts. The reviewers recommended the addition of items that ask students about their overall effort in the experiment and their particular effort in the training and acquisition phases. The experts also recommended the addition of an item that asks participants from the experimental group if they would use the SOAR study strategy for learning from multiple online resources in the future and their reasons for doing so. Following the initial content validation, three graduate students volunteered to take-part in a pilot interview. Each provided feedback on the questions in the IP and the instructions for the interview. As a result, the initial instructions for the interview were modified to include a statement on the purpose of the interview.

Assessment materials. Two rubrics were created by the researcher for use in this study: Study materials scoring rubric and relationship items rubric. Rubric overviews are discussed in this section while scoring details are discussed in the scoring section.

Study materials scoring rubric. A Study Materials Scoring rubric was developed based on the analytic scoring rubric framework recommended by Moskal (2000). The Study Materials Rubric is available in Appendix K.1.

First, the rubric identified four criteria that needed to be displayed in students' study materials to demonstrate proficient performance: selection of information and completeness of ideas captured, use of organizers to summarize information, identification of associations in the study material, and regulation of information by generating potential test questions. Second, each of the four criteria was defined for the top level of performance to create meaningful distinctions between the criterions. For selection of information a table containing all idea units in the text was created in Table 14 (see Appendix K.1). Third, sub-criteria for each of the four main criterions were identified to offer greater distinctions among the four main criterions. Forth, a numeric point value was assigned to each sub-criterion (scoring details are available in the quantitative analysis section below).

Next, reliability and validity of the Study Materials Scoring rubric were established. It is recommended to establish reliability before validity (Gay, 1987). Two steps were taken to establish inter-rater reliability. To begin, two graduate research assistants were asked to independently score one set of student notes from a pilot study. Scores from each rater were compared to formalize each of the four criterions and guide modifications in the rubric. Average pairwise Cohen's Kappa was calculated as 0.9. As a result, two idea units were added to Table 14 (see Appendix K.1) in the selection section of the rubric and the definition of the efficiency rating was added to the rubric.

Then, intra-rater reliability was established for the Study Materials Scoring Rubric. The researcher scored one set of student notes from the pilot study twice, one week apart. Results were compared to assess influences that were internal to researcher. Average pairwise Cohen's Kappa was calculated as 0.9.

Rubric content validity was established. The rubric was evaluated by an expert on developing scoring rubrics for notes. Feedback from the expert was used to guide modifications in the rubric. As a result a list of local and global associations was added to the study material rubric. To establish criterion validity, a list of desired outcomes in student materials was developed; outcomes were compared against the rubric criteria to address any outcome that the criterions did not cover. The outcomes matched the criteria in the study rubric material and no modifications were needed.

Relationship items rubric. The relationship items rubric was developed based on the analytic scoring rubric framework recommended by Moskal (2000). This rubric was used to score the ten relationship items from the achievement test. The relationship items rubric is available in Appendix K.2. The rubric identified the ten complete answers that needed to be displayed in students' answers to demonstrate proficient performance on each question. Each of the ten answers was defined for the top, middle, and lower level of performance to create meaningful distinctions among answers. Top level performance was defined in the rubric as a: complete answer. A complete answer was one that identified a correct and complete relationship. Middle level performance was defined in the rubric as an: incomplete answer. An incomplete answer was an answer that identified each idea in the relationship, but failed to connect them to make the relationship. Low

level performance was defined in the rubric as an: incorrect answer. An incorrect answer was an answer that stated an incorrect relationship or no relationship at all.

For example, Question 6 asked students to identify the relationship between an Ape's weight and life span in the wild. A complete answer would be "*The more an ape weighs, the longer its lifespan in the wild*." Here, the student identifies the relationship between the lifespan in the wild and an apes' weight. An incomplete answer could be "*Gorillas weigh 300lbs and live for 40 years in the wild. Orangutans weigh 200lbs and live for 30 years in the wild. Chimpanzees weigh 110lbs and live 25 years in the wild. Siamangs weigh 30lbs and live for 20 years in the wild. Gibbons weigh 20lbs and live 15 years in the wild*." This is an incomplete answer because the correct weight and lifespan for each ape is stated, but no relationship between the weight and life span is stated. An incorrect answer would be to state a false relationship such as "*Gorillas weigh 200lbs and live for 10 years"* or no relationship such as" *Apes live between 15 and 40"* years in the wild.

Next, reliability and validity of the relationship items scoring rubric were established. It is recommended to establish reliability before validity (Gay, 1987). Two steps were taken to establish inter-rater reliability. First, three graduate research assistants were asked to independently score three sets of relationship items from a pilot study. The scores from each rater were compared. The graders disagreed on the grading of Questions 6 and 7 in each set. The graduate students met with the researcher to guide modifications to the item in the rubric and an agreement on scoring was reached. Krippendorff's alpha (interval) was .88.

Rubric content validity was established. The rubric was evaluated by an expert on developing scoring rubrics for relationship items. Feedback from the expert was used to guide modifications in the rubric. As recommended by the expert, the descriptions in the incomplete answer column were modified to include examples of each item. To establish criterion validity, a list of desired answers was developed; outcomes from the pilot study were compared against the rubric criteria to address any outcome that the criteria did not cover. There was no evidence of outcomes that were not covered by the criteria in the rubric and, therefore, no modifications were made to the rubric.

Procedure

Students from both groups followed the same procedures and participated in the same six phases in the following order: preparation, pre-survey, training, acquisition, testing, post-survey, and interview. This section provides details about each phase.

Preparation phase. Before students arrived, each computer had the "index.html" homepage open and ready on the screen with the general experiment instructions (see Appendix G.3). A table was set up by the lab entrance door with a bag of random numbers and a folder for each student. The folder contained a printed consent form (see Appendix G.2), a notepad, a blue pen, and a red pen.

The students gathered at the lab for the time slot they registered for. Upon arrival, each student selected a random number from the bag containing 300 folded pieces of paper. Each piece of paper had a printed 5-digit number. The numbers were generated using a random numbers table generator. The first two digits were used to assign students randomly into groups. If the first two digits of the number that the student selected were

> 50, then she or he was directed to sit at a table for the experimental group. If the first two digits of the number that a student selected were < 50, then he or she was directed to sit at a table for the control group. For example, if a student selected the number 78632 from the bag, then she or he would belong in the experimental group. If a student selected the number 32479, then she or he would belong in the control group.

The number that the student selected became their assigned five-digit number. They were asked to write their assigned number on the top of the first page of their notepads. Then, students were given the option to sign a consent form in their folders. Students that agreed to sign the consent form wrote their assigned five-digit number on the form.

Pre-survey phase. Once all students were seated, general instructions for the experiment were given. Students were asked to make sure they had a note-pad, red and blue pens, and a five digit number. They were asked not to touch the mouse or keyboard until instructed to. In addition, students were asked to turn off or mute their cell phones for the period of the experiment (Appendix G.3). Students were then instructed to click on the "Next" button on the homepage to go to the pre-survey page.

Students were directed to complete a pre-survey. The survey was administered on the offline website. A pop-up window appeared on their screen asking them to click on the "Open Survey" button to complete the survey. Students were given 5 minutes to complete the survey. The survey took approximately 3 – 4 minutes to complete. Once the survey was complete, students were provided with a link to the training page.

Training phase. Students were presented with an introduction to the training page with training phase instructions. The instructions asked students from both groups to: (a) use the red pen while taking notes, (b) write down their assigned five-digit number on their notepads, (c) to not click on the backspace button during the experiment, (d) turn off their cell phones, (e) confirm they had a consent form, and (f) sign the consent form if they would like to allow their study materials to be included in the data analysis. Then, students were asked to click on the blue "Play" button on their screens to begin their training. Training material was hosted on the offline website. Each group was presented with training in their respective study strategy. The control group was trained using their preferred study strategies and the experimental group was trained in SOAR. The total time for this phase was 30 minutes for both groups.

Training material samples for the experimental group are provided in Appendices B.3 and B.4 and for the control group are provided in Appendices B.1 and B.2. Training instructions can be found in Appendices L1. and L.2 for each group respectfully.

Acquisition phase. In the acquisition phase students were given time to create study materials and time to revise them. Once training was complete, students were directed to a new page on the offline website. This page contained general instructions for the acquisition phase that asked students to study the materials presented to them in preparation for a test. They were given access to the search engine results page with hyperlinks to webpages containing information on the five types of Apes. They were

encouraged to use the notepad provided to them to develop study materials during a 30 minute period. Students were instructed to use the blue pen during this phase.

Once the 30 minutes passed, students were asked to click on the password protected "Next" button located toward the bottom of the search engine homepage. Students entered the password given to them to navigate to the next screen where a countdown timer was displayed. Students were given 10 minutes to study from the study materials they created in preparation for the achievement test. Finally, all students were asked to put away their study materials, pens, and consent form in the folder given to them. The researcher gathered the folders. Two samples of students' study materials created in this phase are provided in Appendices C.2 and C.3.

Testing phase. Immediately following the acquisition phase, the achievement test was administered in three stages: concept items, relationship items, and fact items. All students were given 15 minutes to complete the test. They were asked to use the full time and remain in their seats until the time had passed. Students were not able to navigate to sebsquent items without completing the items they were on. When a student chose to move to the subsquent items, she or he was not allowed to go back to previous ones. The test items are provided in Appendices D.1, D.2, and D.3.

Post-survey phase. After students completed the achievement test, a pop-up window appeared on the screen asking them to click on the "Open Survey" button to complete the post-survey. The survey took approximately 6 to 10 minutes to complete. The post survey was the final phase in the two hour period.

Interview phase. After all students completed the experiment, an invitation to participate in a follow-up interview was sent out via email. An insufficient number, ten students volunteered in response to the first invitation, therefore, a second invitation was sent a month after the experiment was completed and five additional students volunteered. Seven students were from the control group and eight students were from the experimental group (n = 15).

Students who volunteered to take part in the interview met with the researcher one-on-one in a conference room on campus. Upon arrival, students were asked to sign a consent form for the interview (see Appendix G.1). Interviews began with a brief explanation of the purpose of the study followed by an ice-breaker question. During the interview, a laptop using a sound recorder application was used to acquire the conversation. Some brief notes were taken during the interview. Figure 6 represents the procedure phases of the research intervention. This figure represents the experiment procedures for quantitative and qualitative stages.

Research Variables

Independent variable. This study had one independent treatment variable that was manipulated by the researcher. The treatment variable was the study strategy used by students to learn from multiple online resources. For the experimental group, SOAR training and instructions to use SOAR during acquisition phase, whereas the control group used their preferred study method.

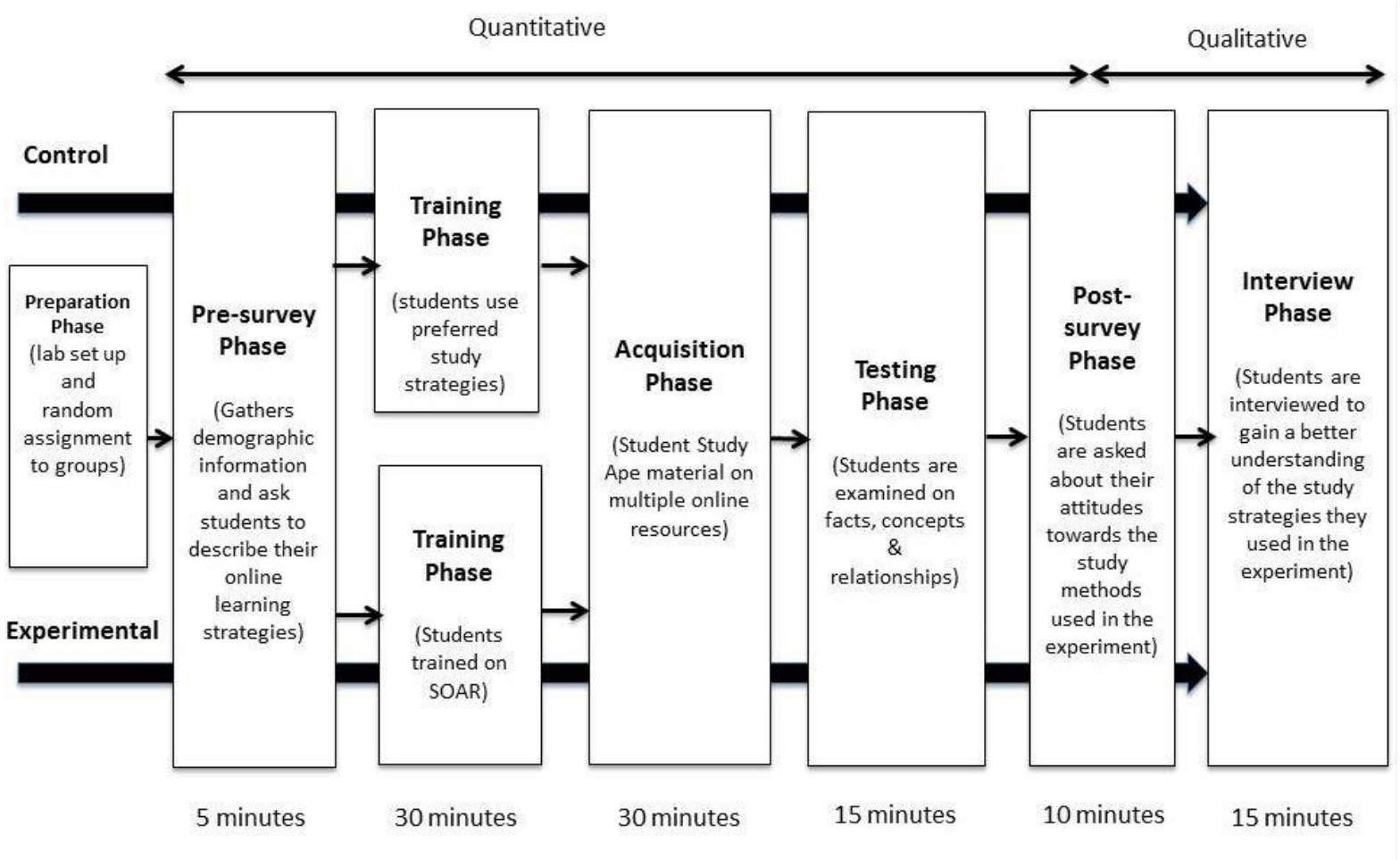


Figure 6. Procedures representation.

Dependent variables. Four main dependent variables were identified in this study in relation to the first quantitative research question "*Does SOAR impact students' achievement as measured by performance on fact, concepts, and relationship items when learning from multiple online resources?*"

a) Students' total score on the achievement test. This dependent variable refers to students overall performance on the three item types: fact, relationship, and concept.
b) Students' performance on concept items (CI). This dependent variable refers to students' total score on the concept items.
c) Students' performance on relationship items (RI). This dependent variable refers to students' total score on relationship items.
d) Students' performance on fact items (FI). This dependent variable refers to students' total score on the fact items.

Nine dependent variables are identified in this study in relation to the second quantitative research question "*Does SOAR impact the completeness and quality of students' generated study materials with respect to selection, organization, association, and regulation of information when learning from multiple online resources?*"

a) Three dependent variables are identified in terms of students' selection of information: the number of idea units presented in their study materials, the number of words used to describe the ideas, and efficiency rating.

b) Two dependent variables are identified in terms of students' organization: apparent use of a graphic organizer in the study materials and number of cells in each organizer.

c) Two dependent variables are identified in terms of students' association: the number of local associations and the number of global associations that students wrote in study materials.

d) Two dependent variables are identified in terms of students' regulation: number of generated fact questions and number of generated relationship questions. Figure 7 represents the research variables in this study.

Figure 7 represents the independent and dependent variables of the study.

Scoring and Data Analysis

Data analysis in a mixed methods study builds on the procedure of collecting data in quantitative and qualitative research (Creswell & Plano Clark, 2011). The types of data collected were defined by the research design. The present study applied the explanatory sequential mixed methods research design that implies that two types of data were collected throughout the study in a sequential fashion. Therefore, the quantitative data were analyzed followed by the scoring and analysis for qualitative and quantitative analysis.. This section describes the analysis of each data set gathered in the experiment.

Quantitative measures. The quantitative data in this study were gathered in the: Pre-survey, student study materials, achievement test (fact, concept, and relationship items), and Post-survey. Data were exported in from Qualtrics into a spreadsheet. SPSS

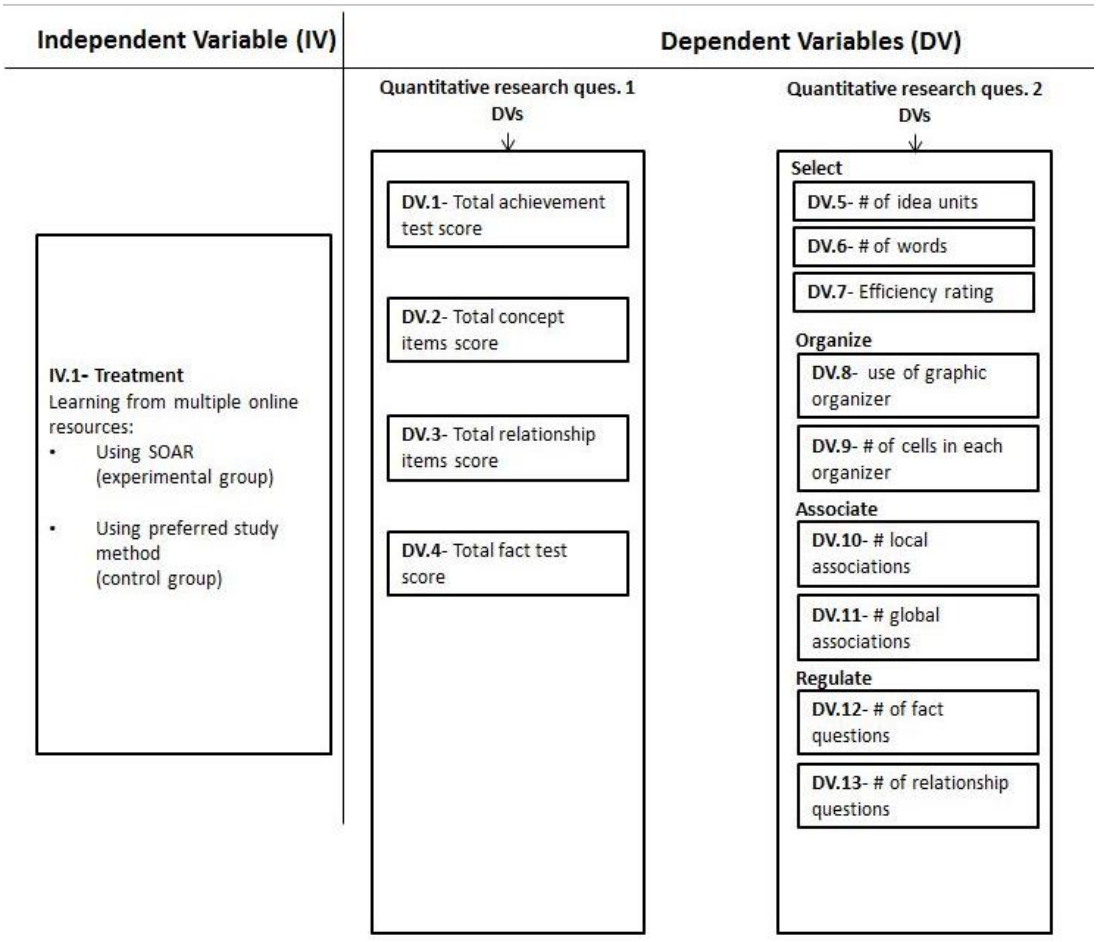


Figure 7. Research variables model.

was used to convert the numeric data from the exported spreadsheet. Then, an appropriate statistical test was run for each data set. This section explains the analysis of data gathered via each quantitative instrument.

Pre-survey. The analysis of the quantitative data gathered in the pre-survey required only frequency and percentage calculations for each item.

Achievement test. The achievement test was worth 60 points and contained three item types: fact, concept, and relationship. The fact items contained 10 questions.

Students recorded their answers online, and answers were computer scored. Each answer was worth 2 points for a total score of 20 points.

The concept items contained 5 questions. Students recorded their answers online, and answers were computer scored. Each answer was worth 4 points for a total score of 20 points.

The relationship items were scored using the relationship items rubric. The rubric was developed based on the analytic scoring rubric framework recommended by Moskal (2000). The rubric contained three levels of scoring: A *complete* answer that is worth 2 points, an *incomplete* answer that is worth 1 point, and an *incorrect* answer that is worth 0 points. The total possible points were 20. A research assistant and the researcher in this study independently scored the relationship test answers using the relationship items rubric. The scoring results were compared and six discrepancies were found. The researcher and research assistant discussed the items and agreed on a score.

Following scoring, results for the three item types were uploaded to SPSS. Then, a one-way between subjects ANOVA was used to determine any significant differences between the means for the control and experimental groups for the achievement test. A one-way multivariate analysis of variance (MANOVA) was used to simultaneously compare the group means across three item types: fact, concept, and relationship scores for the control and experimental groups and to determine the interactions taking place among the independent variables.

Study materials. The study materials that students created during the acquisition phase were scored for quality and completeness. A study material scoring rubric was

developed based on the analytic scoring rubric framework recommended by Moskal (2000).

The study materials scoring rubric identified four criteria for evaluation. The first evaluated criterion was students' selection of information. A complete list of facts, from the five online resources on Apes, was compiled into Table 14 (see Appendix K.1). Students' selection of information was evaluated on three criteria: number of idea units, number of words, and efficiency rating. First, the Ape material contained 103 idea units. The number of idea units was counted and each idea unit recorded was worth 1 point. Second, total number of recorded words was counted and each word was worth 1 point. Third, efficiency rating was calculated. The efficiency rating is the average words used to express an idea. To calculate efficiency rating number of idea units was divided by number of words. For example, if a student used 500 words to describe 100 idea units, then the student would have a score of 100 for the idea units, 500 for the number of words used, and an efficiency rating of 0.2 (100/ 500).

The second evaluation criterion was students' organization of the selected information. Students' organization was scored on (a) frequency of apparent graphic organizers such as matrices, tables, and concept maps (each apparent organizer was worth 1 point); and (b) number of cells in each organizer (each cell in the organizer was worth 1 point).

For example, if a student had an organizer similar to Table 3 in their study materials, then they would score 1 point for the organizer, and 30 points for the number of cells.

Table 3

Example of Student Organizer

	1.	2.	3.	4.	5.	6.
1.	Categories/ Ape	Gorillas	Orangutans	Chimpanzees	Siamangs	Gibbons
2.	Family	Greater ape	Greater ape	Greater ape	Lesser ape	Lesser ape
3.	Genus	Gorilla	Pongo	Pan	Hylobates	Hylobates
4.	Weight (lbs)	300	200	110	30	20
5.	Height (ft)	6	5	4	3	2
6.	Life Span (wild)	40	30	25	20	15
7.	Habitat	Low land	Low land	Low land	Tree dwelling	Tree dwelling

The third evaluation criterion was evidence of association of information in notes. Two types of associations were scored. The first type was local associations. This refers to associations that identify an idea that is common between two or more apes. An example of a local association from Table 3 would be "*Three apes are lowland apes.*" In this example, the identified idea is the common habitat for 3 of the apes across Row 7. Another example is "*All apes range between 2 to 6 feet tall.*" In this example, height of the five apes is the common idea.

The second type of scored associations was global associations. A global association refers to an association that identifies two or more ideas common between two or more apes. In Table 3, a global association would be identified across two or more rows or columns. An example of a global association from the table would be "*The*

greater apes are taller than the lesser apes." This example associates the ape heights from Row 5 with the ape family from Row 2. A second example is "*Low land apes live longer in the wild than tree dwelling apes.*" The association is between the apes' habitat and their lifespan in the wild. Each association was worth one point.

The fourth and final criterion was students' regulation of information. Regulation of information was scored in terms of the number of fact and relationship questions generated. Each question was worth one point. A research assistant and the researcher in this study independently scored the study materials using the study materials rubric. Afterwards, the researchers' scoring results were compared with the research assistants' scoring result. The results for the majority of scores were the same for both graders. When differences occurred, both graders discussed the differences and came to an agreement.

After students' study materials were scored, separate t-test procedures were used to compare the means of the experimental and control groups' performance on quality of study materials created for each item in the rubric: (a) number of idea units, (b) number of words used, (c) efficiency rating, (d) apparent organizer, (e) number of cells in each organizer, (f) number of local associations, (g) number of global associations, (h) number of fact test questions, and (i) number of relationship test questions.

Next, the Pearson product-moment correlation coefficient was computed to measure the strength of the linear relationships between each criterion in the study materials rubric and the three item types. Because test scores and note score were from different normal distributions, scores were standardized and converted to z-scores.

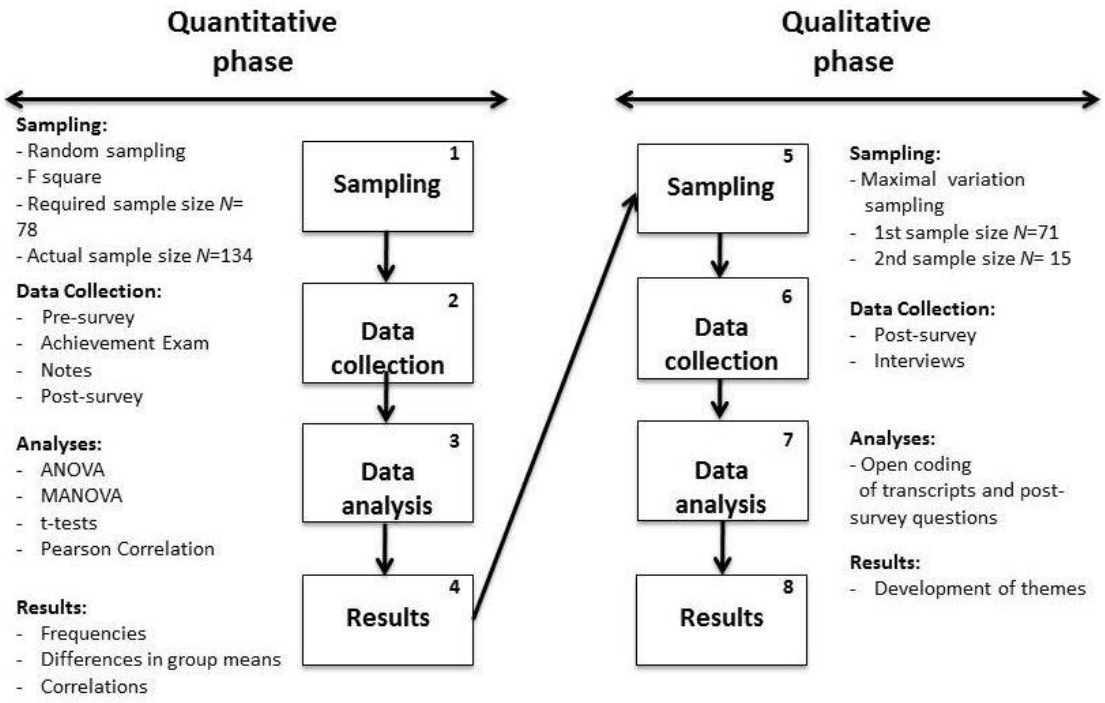
Post-survey. Students from both groups participated in the post-survey. Students were asked to rate their study experiences the training phase, acquisition phase, and for future learning of online materials and course content. A total of seven items were rated. Rating choices ranged from 0 to 10 and were computer scored. Results were exported into a CSV spreadsheet then uploaded to SPSS. Frequency and percentage analyses were conducted followed by independent *t*-tests used to compare the means between the experimental and control groups' attitudes on each of the seven items in Question 2.

Qualitative measures. Qualitative data were gathered in the pre-survey, post-survey, and interview phases. One hundred and thirty-four (134) students answered an open-ended question in the pre-survey asking them to describe in detail the steps that they take when learning from multiple online resources. Seventy-one (71) students from the experimental group were asked to select which of the four SOAR components was the most and least useful and describe their reasons in an open-ended question.

The pre- and post-surveys stored the results online. The results were exported into an XLSX spreadsheet as strings of text. Each answer from each student was saved into its own word document and titled with the student number. The interviews were recorded on a computer using a sound recorder application. All interviews were transcribed. Each transcription was saved in a separate word document. Then, three projects were created in MAXQDA: one for pre-survey, a second for post-survey, and a third for interview transcripts. The text documents containing students' answers on the pre-survey, post-survey, and transcriptions were loaded into the appropriate project. Once the data were

loaded into MAXQDA, they were analyzed using strategies proposed by Creswell (2008) for coding qualitative data.

Data gathered from all three qualitative instruments were analyzed in similar fashion. The open—coding analysis strategy was used. A research assistant and the researcher independently and carefully reviewed the data and read each line in the texts. While reading, they both identified ideas, behavior patterns and commonalities in the texts. These patterns were color coded in MAXQDA. From these codes, the first set of themes emerged. To ensure quality analysis and to identify inter-related themes, the coding process was repeated. Data were sorted and coded a second time to group themes from the first open-coding. Then, the researcher and research assistant met and discussed the emerged themes. They identified the strongest themes that emerged from the data. These themes were reported in chapter four. Figure 8 summarizes the research design including sampling, data collection, data analysis, and results for quantitative and qualitative phases.



* The research model applied in this study had a slight variation from the mixed methods explanatory research design explained by Creswell and Plano Clark (2011), both quantitative and qualitative data were gathered in the pre-surveys.

Figure 8. Explanatory mixed methods research design model.

Chapter Four

Results

This study followed an explanatory mixed methods research design consisting of two phases: a quantitative phase followed by a qualitative phase. The quantitative and qualitative results are reported in this section.

The purpose of the data obtained in the quantitative phase was to gather demographic information, compare the SOAR strategy group and the preferred strategy group's test performance and on quality of study materials, and to identify the most and least useful components of SOAR.

The overarching quantitative research questions for this study were: *Does SOAR impact students' achievement as measured by performance on fact, concepts, and relationship items when learning from multiple online resources?* and *does SOAR impact the completeness and quality of students' generated study materials with respect to selection, organization, association, and regulation of information when learning from multiple online resources?*

The quantitative research instruments used to gather quantitative data were: (a) pre-survey, (b) fact items, (c) concept items, (d) relationship items, (e) post-survey, and f) study materials.

The purpose of the data obtained from the qualitative instruments was to better understand the steps that college students follow when learning from multiple online resources, to gain insight into students' attitudes towards the SOAR study strategy, and into the differences between students preferred study strategies and the SOAR study

strategy. The qualitative methods provide insight into issues difficult to measure using quantitative methods.

The overarching qualitative research questions were: *What study strategies do untrained students use when learning from multiple online resources?* and *What are students' attitudes towards using the study strategies presented in the experiment when learning from multiple online resources?* The qualitative research instruments used to gather qualitative data were: (a) pre-survey, (b) post-survey, and (c) interviews.

Results of the analysis for each instrument are reported below in the order they appeared in the procedures.

Pre-survey Results

One hundred thirty-four (134) students from the SOAR strategy and preferred strategy group participated in the pre-survey. The pre-survey contained a total of 8 questions. Questions 1 through 5 gathered demographic information (see *Participants and Design* section in Chapter Three), Questions 6 and 7 gathered quantitative data, and Question 8 gathered qualitative data.

Question 6 asked students if they were familiar with the SOAR study strategy. Results show 0% of students (n = 134) were familiar with SOAR at the time of the experiment. Questions 6.a and 6.b were sub-questions only shown to students who answered "*Yes*" to Question 6. None of the students answered "Yes" to Question 6, therefore no frequency data were gathered for those two sub-questions.

Question 7 asked students if they have ever been asked by any of their college instructors to use the Internet to independently learn about a topic introduced in class.

Results show that 68% of students (n = 91) have been asked by their college instructors to learn independently from online resources for a course that they participated in. Those 91 students were then asked if that instructor provided them with a study strategy or method to assist them when learning online. Only 28% of students (n = 26) reported that their instructor provided them with a study strategy to assist them in their independent online learning.

In an effort to understand the strategies that students follow when studying from multiple online resources, Question 8 asked students to describe in detail the steps that they typically follow when learning online. The qualitative open-coding analysis identified the following themes: (a) begin with a search engine, (b) read information on reliable websites, (c) take notes, and (d) summarize and memorize. Themes are discussed below.

Begin with a search engine. Identifying resources via search engines was a strong theme that emerged from the data. Almost all students stated that the first step to learning online should be to start with a search engine (n = 131). Google search, YouTube, and university library websites were the most common websites that students use to look for online resources. For example, one student said:

> *I typically go to a reliable database such as the university's library website and do a search, browse the results, read through the results that seem fitting and useful, take notes or print off articles/webpages that pertain to what I was studying then summarize the information in my notes*.

Another example was "*I would open up an internet browser, go to google.com, and search the topic. I would then select a few of the top recommended articles or readings from the first page of suggestions.*"

Students stated that they typically insert a few keywords in the search engine that describe the topic that they are studying.

Read information on reliable websites. The second step is to skim the search results to locate a reliable website and read available information. Students (*n* = 109) used words like "creditable," "legit," "useful," "accurate," and "good" interchangeably to define what a reliable website is in their opinion.

Students said that they skim through the first page of results and then select a few websites to read. Several indicated that they select around three to four preferred sites. They selected their preferred websites based the website description available to them on the search results page or the first few sentences on the page. For example, one participant said: "*I would skim the results for websites that I believe are reliable. It is easy to find those because you can read the short description about a website before you open it. . . . "*

Some students reported that they typically save a list of links to websites in case they need to go back to them by bookmarking them in a browser or copying the links into a separate word document.

Taking notes: Students expressed the importance of taking notes from websites that they deem reliable (*n* = 96). They use a word processor to write notes or copy/paste text from websites in the word processor. Some students reported that they print the pages and then write comments on the hard copy using a pencil. No strong preference was given to one strategy over the other. One participant said:

> *As I was looking it over, I would take notes about the things that stood out as being important to me. If I find a site with a lot of information that I like, I would copy it into Word and highlight the important stuff.*

Students reported that note-taking is done by copying and pasting chunks of text from websites they find into a word document, combining similar information under common headings, and highlighting main ideas.

Summarize then Memorize. After taking notes, students summarize information and then memorize main points (n = 89). Students believed that highlighting text and copying information into a word processor should be followed by paraphrasing and summarizing information in their own words. Once summaries are complete, students try to memorize information using rehearsal techniques. Students stressed the importance of memorization for learning. For example, one participant said:

> *Next, I will read through the online material and try to write down what I think are the most important and useful points. I would repeat this until I had all the material I need for the topic. Then I would try to memorize all the important things in my notes*.

In summary, students reported that they begin with a search engine to identify resources with information that is reliable. Then they take notes in a word processor or on paper. Last, they summarize information in their notes and memorize ideas. Examples of student answers to Question 8 in the pre-survey can be found in Appendix N.1.

Study Materials Analysis

The study materials scoring rubric was used to score the quality of students' study materials created during the acquisition phase in terms of: (a) selection, (b) organization, (c) association, and (d) regulation. Following scoring, separate t-test procedures were

used to compare the means of the experimental (SOAR strategy) and control (preferred strategy) groups' study materials for each item on the rubric.

Table 4 summarizes significant results for select, organize, associate, and regulate.

Table 4 shows that students in the SOAR strategy group scored significantly higher than students in the preferred strategy group on organize, associate, and regulate components. This means that the SOAR strategy group created better quality study materials than students in the preferred strategy group. Details of the t-test analysis for each component are described in turn. Bonferroni adjusted alpha level of .006 (0.05/9) was used to determine p value significance per test.

Select. Students' selection of information was evaluated on three criteria: number of idea units, number of words used to describe ideas, and efficiency rating.

Number of idea units. The two groups did not differ in terms of number of idea units recorded in study materials $t(118) = 1.54$, $p = .126$, Cohen's $d = 0.28$. The study materials created by the SOAR strategy group contained an average of 59% of the idea units ($M = 60.78$, $SD = 26.35$), whereas the preferred study strategy group noted an average of 52% of the idea units ($M = 54$, $SD = 22.011$) from a total of 103 ideas presented in the ape texts. Overall students recorded around the same number of ideas and captured a relatively high number of ideas.

Number of words. The two groups did not differ in terms of the number of words used to describe the idea units in the noted section of the study materials, $t(117) = .1$, $p = .32$, Cohen's $d = 0.18$. The study materials created by the SOAR strategy group contained an average of 188 words to describe 59% of the total idea units, ($SD = 95.3$),

Table 4

Summary of Significance of Subcategories in the Study Material Scoring Rubric

	Select			Organize		Associate		Regulate	
	# of idea units	# of words	Efficiency rating	Use of organizer	# of cells	Local associations	Global associations	Rel. ques.	Fact ques.
SOAR group	--	--	--	*	*	*	*	*	*
Preferred group	--	--	--	--	--	--	--	--	--

[a] -- = Non-significant
[b] * = Significant

whereas the preferred strategy group study materials contained an average of 208 words to describe 52% of the idea units, (*SD* = 117.22). Although SOAR training had a minimal effect on the number of words presented in the study materials, the results demonstrate that the SOAR group used fewer words to describe more ideas than the preferred strategy group as shown in the efficiency rating next.

***Efficiency rating*:** Efficiency rating was calculated by dividing number of words students recorded in study materials by the total number of idea units recorded. Table 7 overviews results based on the *t*-test analysis. The two groups did not differ in terms of efficiency rating, $t(121) = 1.27$, $p = .21$, Cohen's $d = 0.23$. Students in the SOAR strategy group used an average of 3 words to describe 1 idea unit, $M = 2.98$, $SD = 1.46$. Students in the preferred study strategy group used an average of 5 words to describe 1 idea unit, $M = 5.19$, $SD = 13.43$. Although SOAR training had a minimal effect on efficiency rating, the results demonstrate that the SOAR group was somewhat more efficient when taking notes from multiple online resources than the preferred strategy groups.

Organize. Students' organization of information was evaluated on two criteria: apparent use of a graphic organizer and number of cells in each organizer.

Use of an organizer. The SOAR strategy group created more organizers than the preferred strategy group, $t(105) = 7.6$, $p = .00$, Cohen's $d = 1.5$. Only 25% of students in the preferred strategy group created an organizer (*SD* = .54), whereas 100% of students in the SOAR strategy group created one (*SD* = .43).

Number of organizer cells. The SOAR strategy group created more cells than the preferred strategy group, $t(113) = 3.40$, $p = .001$, Cohen's $d = 1.05$. On average, the SOAR strategy group had 40 cells (SD =16.70) per student and the preferred strategy group had 22 cells (SD = 17.50) per student. The number of cells in an organizer indicates the completeness of the organizer created. As the number of cells in an organizer increase the number of idea units captured in the organizer increase. The t-test analysis showed that SOAR training had a large effect on the number of cells contained in organizers.

Overall, the results for the organization component show that not only did 100% of students in the SOAR strategy group create and use an organizer when learning from multiple online resources, but they created one that that was detailed, capturing an average of 38 idea units from the ape texts. Only 25% of the preferred strategy group created an organizer. Their organizers lacked detail and only captured an average of 8 of 103 idea units.

Associate. Students' association of information was evaluated based on two criteria: number of local associations and number of global associations contained in study materials. A local association relates information within a single topic or single category. A global association relates information across multiple categories.

Number of local associations. The SOAR strategy group generated more local associations than the preferred strategy group, $t(103) = 5$, $p = .00$, Cohen's $d = 0.93$. On average, the SOAR strategy group generated 2 local associations (SD = 2.25), whereas the preferred strategy group created on average 0.5 local associations (SD = 1.55).

Number of global associations. The SOAR strategy group generated more global associations than the preferred strategy group, $t(57) = 4.57$, $p = .00$, Cohen's $d = 0.87$. On average, the SOAR strategy group generated .02 global associations ($SD = 1.03$), whereas the preferred strategy group generated none ($SD = 1.55$).

Although the analysis of the associate component demonstrates that students from the SOAR strategy group created more local and global associations in their study materials than the students in the preferred strategy group, the number of associations generated by the SOAR strategy group was low (less than 3 on average).

Regulate. Students' regulation of information was evaluated on two criteria: number of generated fact questions and number of generated relationship questions.

***Number of generated fact questions*.** The SOAR strategy group generated more fact questions than the preferred strategy groups, $t(58) = 5.5$, $p = .00$, Cohen's $d = 1.003$. On average, the SOAR strategy group generated 2 fact questions ($SD = 2.5$), whereas the preferred strategy group generated .036 fact questions ($SD = 0.27$).

***Number of generated relationship questions*.** The SOAR strategy group generated more relationship questions than the preferred strategy groups, $t(57) = 3.3$, $p = .00$, Cohen's $d = 0.45$. On average, the SOAR strategy group generated .5 relationship questions ($SD = 1.12$), whereas the preferred strategy group generated none ($SD = .00$).

Overall, analysis of the regulate component shows that students trained in SOAR created more fact and relationship questions to regulate learning from multiple online resources than students using preferred strategies. The actual number of practice test questions created by SOAR students was low (less than 3 questions on average).

Achievement Test Results

An achievement test consisting of three item types was administered to students. The three item types were: fact, concept, and relationship. Two analyses were conducted: First, a one-way between subjects ANOVA was used to determine differences between the SOAR strategy and preferred strategy groups for total achievement test score. Second, a follow up one-way multivariate analysis of variance (MANOVA) was used to compare means for the SOAR strategy and preferred strategy groups for each item type: fact, concept, and relationship. To meet the assumptions for MANOVA, it is best to have approximately equal numbers of participants in each group. The largest group size (n = 71) was no more than 1.5 times larger than the smallest group size (n = 63) as recommended by Yockey (2011). Table 5 confirms an approximately equal number of participants in each group and presents the descriptive statistics for the groups indicating a close group size.

Table 5

Descriptive Statistics for Facts, Concepts, and Relationships Among Concepts Tests

	Preferred (n = 63)		SOAR (n = 71)	
	M	SD	M	SD
Concepts	4.60	2.45	5.70	2.48
Relationships	7.73	3.53	13.94	2.74
Facts	6.56	1.90	7.42	1.65

Box's Test of Equality of Covariance was used to check the assumption of homogeneity of covariance across the groups at $p < .001$. Box's M (7.25) was not significant, p (.315) > α (.001). Therefore, the assumption is not violated and Wilk's Lambda is an appropriate test to use.

Results of Wilk's Lambada test at an alpha level of .05 show that the test was significant, Wilk's $\Lambda = .48$, $F(3, 130) = 46.4$, $p < .001$, multivariate $\eta^{2} = .517$. The results show approximately 51% of multivariate variance of the dependent variables was associated with the group factor.

The Levene's test of equality of error variances was used to test the assumption of MANOVA that the variances of each variable are equal across groups. Results indicate that the test was not significant ($p > .05$) and the assumption is met for the three dependent variables: concept ($F = .04$, $p = .43$), relationship ($F = 2.24$, $p = .14$), and fact ($F = 1.11$, $p = .30$). For interpretation purposes, effect sizes 0.01 - 0.059 are considered a small effect, 0.06 – 0.139 are considered a medium effect, and 0.14 or higher are considered a large effect (Cohen, 1988).

Total achievement test scores. One-way between subjects analysis of variance (ANOVA) comparing the effect of using SOAR on students' performance on the achievement test was calculated. The SOAR strategy group ($M = 27.05$, $SD = 5.44$, $n = 71$) outperformed the preferred strategy group ($M = 18.86$, $SD = 6.24$, $N = 63$), $F(1,132) = 65.892$, $p < .001$, $(\eta^2) = .33$.

As seen in Column 6 of Table 6, students trained in SOAR scored an average of 68% on the achievement test, whereas students in the preferred study strategy group averaged 47%.

Table 6

Percentage Scores for SOAR Strategy and Preferred Strategy Group on the Fact, Concept, and Relationship Items, and Test Score

	Fact %	Concept%	Relationship %	Total score %
SOAR strategy	74	57	70	68
Preferred strategy	65	45	39	47

Fact, concept, and relationships scores. MANOVA results displayed in Table 7 indicate group differences on fact, relationship, and concept items. No Post Hoc tests were performed because there were only two groups.

Follow-up univariate ANOVAs shown in Table 7, for fact items indicated that SOAR strategy students scored significantly higher than preferred strategy students, $F(1, 132) = 8$, $p < .05$, $\eta^2 = .06$. As seen in Table 6, the SOAR strategy group averaged 74%, whereas the preferred strategy group averaged 65%.

Follow-up univariate ANOVAs shown in Table 7, for concept items indicated that SOAR strategy students scored significantly higher than preferred strategy students, $F(1, 132) = 7$, $p < .05$, $\eta^2 = .050$. As seen in Table 6, the SOAR strategy group averaged 57%, whereas the preferred strategy group averaged 45%.

Table 7

Tests of Between–subjects Effects

Variables	Dependent	Type III Sum of Squares	df	Mean Square	F	Sig.	Partial Eta Squared
Corrected Model	Concepts	41.78[a]	1	41.78	6.90	.010	.05
	Relationships	1288.70[b]	1	1288.76	130.84	.000	.50
	Facts	25.09[c]	1	25.09	8.02	.005	.06
Intercept	Concepts	3514.97	1	3514.10	579.52	.000	.81
	Relationships	15680.69	1	15680.67	1592	.000	.92
	Facts	6522.14	1	6522.14	2085.17	.000	.94
Test items	Concepts	41.77	1	41.77	6.90	.010	.050
	Relationships	1288.75	1	1288.75	130.84	.000	.50
	Facts	25.09	1	25.09	8.02	.005	.06
Error	Concepts	800.61	132	6.10			
	Relationships	1300.19	132	9.90			
	Facts	412.88	132	3.13			
Total	Concepts	4416.00	134				
	Relationships	18869.00	134				
	Facts	7032.00	134				
Corrected Total	Concepts	842.39	133				
	Relationships	2588.93	133				
	Facts	437.97	133				

[a] R Squared = .050 (Adjusted R Squared = .042)
[b] R Squared = .498 (Adjusted R Squared = .494)
[c] R Squared = .057 (Adjusted R Squared = .050)
[d] Computed using alpha = .05

Follow-up univariate ANOVAs shown in Table 7, for relationship items indicated that SOAR strategy students scored significantly higher than preferred strategy students, $F(1, 132) = 131$, $p < .05$, $\eta^2 = .5$. As seen in Table 6, the SOAR strategy group averaged 70%, whereas the preferred strategy group averaged of 39%.

In summary, students trained in SOAR scored higher than students who used their preferred study strategy on the three item types and the total achievement test as well. Moreover, students in the preferred strategy group attained failing scores on the relationship and concept items (scores < 50%).

Correlational Analysis

One hundred and thirty-four (134) students created study materials and took an achievement exam containing fact, relationship, and concept items. The MANOVA analysis indicated a significant effect of SOAR on students' total score on the achievement test and on the three item types. In addition, the *t*-test analyses show a significant effect of SOAR on students' study materials on 7 out of the 9 criteria in the study materials scoring rubric. Therefore, the Pearson product-moment correlation coefficient was computed to measure the strength of the linear relationships between the study materials and achievement test. The correlation coefficients for the Pearson product correlations are summarized in Table 8.

Table 8

Summary of Correlation Coefficients for Pearson Product Correlation Coefficient between Item Types (concept, fact, relationship) and SOAR Study Strategies (select, organize, associate, regulate)

	Select			Organize		Associate		Regulate	
	# of idea units	# of words	Efficiency rating	Use of organizer	# of cells	Local associations	Global associations	Rel. ques.	Fact ques.
Concept Items	.40*	.19*	-.13	.13	.22*	.19*	.13	.13	.17
Relationship Items	.30*	.04	-.09	.50*	.50*	.50*	.4*	.30*	.34*
Fact Items	.30*	.09	-.11	.30*	.30*	.16	.08	.11	.07

***** = significant correlation.

The Pearson's *r* data analysis resulted in the following:

Select correlations. The strength of the linear relationships was computed between the select items from the study materials scoring rubric (number of idea units, number of words, and efficiency rating) and achievement test item types (fact, relationship, and concept).

Idea units. The number of idea units present in students' study materials was positively correlated with concept items, $r(132) = .4$ (moderate), $p < .001$; fact items $r(132) = .3$ (moderate), $p = .004$; and relationship items $r(132) = .3$ (moderate), $p = .001$. As seen in Column 2 of Table 8, as the number of idea units presented in students' study materials increased, scores increased on fact, relationship, and concept items.

Words. The number of words present in students' study materials was positively correlated with concept items $r(132) = .19$ (small), $p = .031$; but was not significantly correlated with fact and relationship items, $p > .05$. As seen in column 3 of Table 8, as the number of words that students used to describe idea units increased, scores on concept items increased.

Efficiency rating. The efficiency rating was not significantly correlated with any of the three item types, $p > .05$. Column 4 in Table 8 shows negative correlations between the efficiency rating and item scores. Although correlations were not significant, results showed that as efficiency rating decreases, achievement scores increase. In other words, students who used fewer words to describe their ideas were more likely to score higher on the achievement exam.

Organize correlations. The strength of the linear relationships was computed between the organize items from the study materials scoring rubric (use of organizer and number of cells in an organizer) and the achievement test items (fact, relationship, and concept).

Organizer use. The use of an organizer in students' study materials was positively correlated with fact items $r(132) = .3$ (moderate), $p = .001$, and relationship items $r(132) = .5$ (large), $p < .001$, but not with concept items. As presented in column 5 of Table 8, students who created an organizer scored higher on relationship and fact items than those students who did not create an organizer in their study materials. Perhaps when students used an organizer, they were able to identify relationships that would otherwise not be apparent in linear notes.

Number of cells. The number of organizer cells appearing in students' study materials was positively correlated with concept items $r(132) = .22$, $p = .05$, fact items $r(132) = .12$, $p = .02$, and relationship items, $r(132) = .2$, $p = .03$. The number of cells in an organizer had a large effect on students' performance on relationship items. As the number of cells in students' organizer increased, the number of idea units captured increased, thus their scores on the achievement test increased as well. These results are consistent with the previous findings in Column 1 of Table 8 that suggest that students' performance on the achievement exam increased when the number of idea units they wrote in the select phase increased. The results of the analysis for the organize component suggest that a comprehensive and detailed organizer can capture more idea units from the online texts than incomplete organizers.

Associate correlations. The strength of the linear relationships was computed between the associate items from the study materials scoring rubric (number of local associations and number of global associations) and the achievement test item types (fact, relationship, and concept).

Local associations. The number of local associations in students' study materials was positively correlated with relationship items $r(132) = .5$ (large), $p < .001$ and with concept items $r(132) = .19$ (moderate), $p = .041$, but not with fact items.

Global associations. The number of global associations in students' study materials was positively correlated with relationship items $r(132) = .38$ (moderate), $p < .001$, but not with fact or concept items.

The results suggest that as the number of local and global associations presented in students' study materials increased, relationship item scores increased. Similarly, the higher the number of local associations, the higher the concept and relationship item scores.

Regulate correlations. The strength of the linear relationships was computed between the regulate items from the study materials scoring rubric (number of fact and relationship questions) and the achievement test item types (fact, relationship, and concept).

Fact questions. The number of generated fact questions in students' study materials was positively correlated with the relationship items $r(132) = .34$, $p < .001$, but not with fact items or concept items.

Relationship questions. The number of generated relationship questions in students' study materials was positively correlated with the relationship items $r(132) = .28$, $p = .002$, but not with the fact or concept items.

Findings suggest that as the number of relationship and fact questions in the study materials increased, students scored higher on relationship items in the achievement exam.

Post-survey Analysis

One hundred and thirty-four (134) students participated in an attitudinal survey from the SOAR strategy and preferred strategy groups. The post-survey results are organized into three main categories: (a) common questions for both groups (Questions 1 -3), (b) preferred strategy group specific questions (Question 4), and (c) SOAR strategy group specific questions (Questions 4 - 7).

Common questions for both groups. Question 1 of the survey, asked students to provide their assigned number and therefore was not included in this analysis. Question 2 asked students their opinions on: (a) study methods used to learn the content presented to them in the training phase, (b) study methods used to study the five Ape online texts in the acquisition phase, and (c) study methods used for future online and content learning.

Table 9 summarizes the results of the t-test analysis for Question 2 in the post survey.

Table 9

Summary of Average Percentage of Agreement Rating out of 10 for the Post-survey

	methods in training Phase			methods in acquisition phase		methods for future learning	
Group	Easy to use	Effective	Enjoyable	Effective	Enjoyable	Online content	Course content
SOAR	7.7	7.1 (.33*)	6.8 (.7*)	7.2	7.6 (.54*)	7.4 (.33*)	7.3
Preferred	7.4	6.3	5.1	7.3	6.3	6.6	7.0

[a]* t-test resulted in a significant difference in the means.
[b] Cohen's *d* effect size values are reported in parentheses. Effect sizes of average agreement rating per group.

Students' rating of study methods used during the training phase.

Easy to use. Students were asked to rate the study methods when learning the content presented to them in the training phase in terms of ease of use. There was no significant difference between the preferred strategy and SOAR strategy groups in terms of ease of use of the study methods presented to them in the training phase, $t(158) = .35$, Cohen's $d = 0.06$. On a 10 point scale with "0" being strongly disagree and "10" being strongly agree, the SOAR strategy group had an average rating of 7.7 ($SD = 1.9$), and the preferred strategy group had an average rating of 7.4 ($SD = 2.25$). The high rating indicates that students overall did not find it difficult to apply the study methods that were presented to them during the training phase.

Effective. Students were asked to rate study methods for studying content presented during the training phase in terms of effectiveness. Students believed that the SOAR study strategy was more effective than preferred study strategies when learning

the content presented in the training phase, $t(158) = .034$, Cohen's $d = 0.33$. On a 10 point scale with "0" being strongly disagree and "10" being strongly agree, the SOAR strategy group had an average rating of 7 ($SD = 2.23$), and the preferred study strategy group averaged 6.3 ($SD = 2.21$).

Enjoyable. Students were asked to rate study methods that they used to learn the content presented in the training phase in terms of enjoyment. Students believed that using SOAR to learn the content presented to them in the training phase was more enjoyable than their preferred study strategies, $t(158) = .000$, Cohen's $d = 0.7$. On a 10 point scale with "0" being strongly disagree and "10" being strongly agree, students from the SOAR strategy group had an average rating of 6.8 ($SD = 2.47$), and students from the preferred strategy group had an average rating of 5.1 ($SD = 2.6$).

In summary, students believed that SOAR was more enjoyable and effective than their preferred study strategies. Moreover, they did not find SOAR more difficult to use than their preferred study strategies.

Students' rating of study methods used during the acquisition phase.

Effective. Students were asked to rate study methods presented to them in the training phase to learn from multiple online resources in the acquisition phase in terms of effectiveness. There was no difference between the groups in terms of how effective the study methods were in the acquisition phase, $t(158) = .79$, Cohen's $d = 0.04$. On a 10 point scale with "0" being strongly disagree and "10" being strongly agree, the SOAR strategy group had an average rating of 7.2 ($SD = 2.28$), and the preferred strategy group had an average rating of 7.3 ($SD = 5.49$).

Enjoyable. Students were asked to rate study methods they used to learn the 5 online Ape texts in the acquisition phase in terms of enjoyment. Students believed that using SOAR was more enjoyable than using their preferred study methods when learning content presented to them in the acquisition phase, $t(158) = .001$,Cohen's $d = 0.54$. On a 10 point scale with "0" being strongly disagree and "10" being strongly agree, the SOAR strategy group had an average rating of 7.6 ($SD = 2.44$), and the preferred strategy group had an average rating of 6.3 ($SD = 2.52$).

Students' rating of study methods for future learning.

Reuse for learning online. Students were asked to rate how likely they were to reuse the study strategies presented to them in the training phase when studying from online resources in the future. Students who were trained in the SOAR study strategy said they are more likely to use it for future learning from multiple online resources than those trained to use their preferred study strategy, $t(158) = .041$, Cohen's $d = 0.33$. On a 10 point scale with "0" being strongly disagree and "10" being strongly agree, the SOAR strategy group had an average rating of 7.4 ($SD = 2.44$), and the preferred strategy group averaged 6.6 ($SD = 2.49$).

Reuse for learning course content. Students were asked to rate how likely they were to reuse the study strategies presented to them in the training phase when studying course content in the future. There was no difference between groups in terms of using the study methods for future learning of course materials, $t(158) = .35$, Cohen's $d = 0.14$. On a 10 point scale with "0" being strongly disagree and "10" being strongly agree, the

SOAR strategy group had an average rating of 7.3 (*SD* = 2.23) and the preferred strategy group had an average rating of 7.0 (*SD* = 2.27).

Online study methods reported by participants.

Question 3 in the post-survey asked all participants to describe in a step-by-step fashion how they studied the online Ape texts. The responses from each group were analyzed separately and then compared.

Preferred strategy group (control). Sixty-three (63) students from the preferred strategy group answered Question 3 in the post-survey. The steps they described when learning online in the pre-survey were similar to their description of how they studied the Ape material when asked during in the post-survey. Thus, the themes that emerged from the qualitative open-coding analysis for Question 3 in the post-survey were consistent with the themes that emerged from Question 8 in the pre-survey. Those steps involve (a) read the information in the provided websites, (b) take notes in notepads, and (c) summarize and memorize the information.

One additional theme emerged from the post-survey. Recognizing their own ineffective study strategies. Although students were not directly asked to comment on their own study strategies, 59% of them (*n* = 37) recognized that the strategies they used were ineffective after taking the achievement test. One participant wrote:

> *The steps I took to study the materials on apes were very similar to how I studied the previous material. I went through each page of Apes one by one and wrote down each of their defining characteristics. Looking back now, I should have included and paid more attention to the genus and species names, which I just glanced over. I also should have spent more time studying similarities within one another. Once I had completed going through each page, I simply went through one by one and studied the same material that I had written down which was the main characteristics of each type of ape. I tried to memorize as much I as could.*

Another participant said:

> *I went through each of the 5 pages and wrote down all the facts that I thought were important, after I created a list of things that were specific to each type of ape then I was able to create an order of how to list them, I tried to list them in the same order among the 5 different types of apes. After I had organized them in a bulleted or paragraph form I began to read over them several times to try and make myself understand and learn the topic at hand. I began to quiz myself in my head to see if I had memorized all the information. I should have tried to see if there were similarities between the apes it was difficult to answer the questions in the relationships test.*

Students in the preferred strategy group admitted to learning in a piecemeal fashion, they realized that it was insufficient to separate the facts about each Ape and learn them one fact at a time. The preferred strategy students recognized that in order to generate complete answers for the relationship items, they should have identified associations among the five Apes. For example, they memorized the life span and weight for each ape, but did not recognize the relationship between the two categories: *the longer the life span, the more it weighs*. Their description of how they created study materials to learn the online ape material shows that few of them did not create an organizer. An organizer would have helped them to quickly identify relationships that existed in the online texts.

SOAR strategy group. Seventy-one (71) students described how they learned the online material on Apes in Question 3 of the post-survey. The qualitative open-coding analysis resulted in the following themes: (a) taking notes, (b) creating charts and tables, (c) relating ideas, and (d) generating test questions. The themes that emerged from the analysis were consistent with their SOAR training. In summary, the SOAR strategy students studied by taking a complete set of notes as recommended in the Select step of

SOAR. Then, they followed what they learned in the training for the Organize step in SOAR. They created a matrix to organize their notes. Next, they used the organizer to associate ideas to one another as they learned in the Associate step of SOAR. Finally, they regulated their learning by creating test questions. Analysis and sample answers for each theme are below.

Taking notes. Students visited each website one at a time and wrote the main ideas from each in their notepad. They described what they wrote down as important facts. This theme was the strongest one to emerge from the analysis; all students in the SOAR strategy group stated that they followed this step. A sample answer was: "*I wrote down the information from the webpages that I found pertinent to what should be known on the test. . . .*" A second sample answer was: "*First I wrote down everything that seemed most important for each type of ape. I wanted to make sure my notes covered all the important information*."

Charts and tables. One hundred percent (100%, *n* = 71) of students in the SOAR group created a table to organize information gathered in their notes. Students described the main benefits of using the organizer as: (a) better identify similarities and differences among the five types of apes, and (b) make it easier to sort through the categories to locate associations. Students mentioned that they spent most of the study time (10 minutes) studying the information in the chart that they created. Creating an organizer is the second step of SOAR.

A sample answer was:

> *Then from there on I would add in all the details that corresponded with the information from all the other ones so that I could compare and contrast each*

> *detail. That's when I then made my chart to organize all of the ideas that I collected and studied. I had a better view of the information when I put it in the chart.*

A second example was: "*Once I had gone through and written down all of the material underneath the categories I started to organize the information in a Table to find similarities and differences.*"

Relating ideas. Fifty-three percent (53%, *n* = 38) of students in the SOAR strategy group related ideas presented in the organizer to each other. Fifty-two percent (52%, *n* = 37) created local associations and 40% (*n* = 28) created global associations in their study materials. Students in the SOAR strategy group reported that they associated noted ideas to each other from the table that they created. For example, one participant said: "*Next I wrote out how each ape was related to one another or how they were not related to one another. It was easy to see how they were related because of the Table I made*."

None of the students provided details describing if they associated ideas across all or some of the apes in response to Question 3 in the post-survey. Thirty-three percent (33%, *n* = 23) reported that they understood the relationships in the table and chose not to write them down in their notes. For example one participant said: "*Then I started looking for relationships from what I could see in the table. I didn't write them, I just skipped to the last step and started quizzing myself*." Another said: "*When I finished creating the table, I looked for relationships in the information I had and quizzed myself so I would remember them, and from there I created possible test questions and quizzed myself on them as well.*"

From these two representative examples, it is apparent that students did not provide reasons for why they selected not to write down the relationships that they recognized in response to this question.

Creating test questions. Thirty-five percent (35%, *n* = 25) of students in the SOAR strategy group created test questions in their study materials. The open-coding analysis for Question 3 in the post-survey showed that the questions they created contained facts relevant only to one ape (for example: *Adult male gorillas are called silver backs because they have a patch of silver hair on their back*) and questions that they believed would come on the test (for example: "*Finally I created a list of fact questions about information that I thought would come on the test like chimps and humans have close DNA"* and "*The last thing I did was making up and answering a few fact questions about the apes*").

SOAR students expressed that they needed more time to generate questions. Twenty-five percent (25%, *N* = 18) reported that they ran out of time before they could write down any relationship or fact questions. Six percent (6%, *N* = 4) reported that they found it too difficult to generate relationship questions. Additional examples of students' responses to Question 3 of the post-survey are in Appendix N.2.

Preferred strategy group specific question. Question 4 in the post-survey administered to the preferred strategy group asked students if they were interested in learning about a study strategy that could assist them when learning from multiple online resources. Sixty-eight percent (68%, *n* = 48) answered yes to Question 4.

SOAR strategy group specific question. Question 4 in the post-survey administered to the SOAR strategy group asked students what they believed was the most useful SOAR component. Organize lead with 70.42% of students (n = 50) selecting it as the most useful SOAR component. Select followed with 21% (n = 15). Associate was chosen by 6% (n = 4), and only 3% (n = 2) of participants chose Regulate as the most useful component.

Question 5 in the post-survey administered to the SOAR strategy group asked students to explain their reasons for selecting the most useful SOAR component in Question 4. The quantitative analysis showed that students selected the Organize component as the most useful one. The qualitative open-coding analysis resulted in the following reasons: (a) group facts together, (b) compare and contrast ideas, (c) organize my notes, (d) quick way to find facts, and (e) prepare me for the test.

Students who selected "Organize" as the most useful component believed that the organizer helped them aggregate information in one location. Doing so made it easier and quicker to find information across the five websites. They also believed that the organizer assisted them in comparing and contrasting information and therefore made it easier to locate relationships between ideas. Students expressed that creating and studying from an organizer played an important role in preparing for the achievement test. Examples of students' answers are presented in Appendix N.3.

Question 6 in the post-survey administered to the SOAR strategy group asked students to select the least useful SOAR component. Forty-one (41) (57.75%) students

chose Associate as the least useful component. Following that were Regulate (30.99%), Organize (9.86%), and Select (1.41%).

Question 7 in the post-survey administered to the SOAR strategy group asked students to explain their reasons for selecting the least useful SOAR component in Question 6. The quantitative analysis shows that students selected the Associate component as the least useful one. The qualitative open-coding analysis resulted in the following reasons: (a) time consuming, (b) difficulty drawing from prior knowledge, (c) no need to write down relationships, and (d) repetitive. . Examples of students' answers are presented in Appendix N.4.

In summary, participants believed that the associate component was time consuming. They expressed that they would have preferred to spend their time reviewing the organizers that they created. They also reported that the associate step was unnecessary and that associations should not be written down because they had already identified relationships when they created the organizer. Therefore they considered the association step repetitive and unnecessary. Students believed that it was difficult to associate information with what they already knew.

Interview Analysis

Follow-up interviews were conducted within five weeks following the experiment. Interviews served two main purposes: first, interviews were conducted to better understand the strategies that students used to learn from multiple online resources during the experiment. Second, interviews were conducted to provide insight into students' attitudes toward using the study strategies presented to them during the training phase.

Fifteen (15) students volunteered to participate in an interview. Seven (7) were from the preferred strategy group (control), and eight were from the SOAR strategy group (experimental). Results of the qualitative analysis for each group are reported next.

Preferred strategy group interview analysis. The preferred strategy group was asked to describe how they learned from multiple online resources during the acquisition phase of the experiment. The qualitative open-coding data analysis for the interviews resulted in similar themes to the data analysis from the pre and post surveys for that group: (a) read the information in the provided websites for each ape, (b) take notes in notepads, and (c) summarize and memorize information.

Two additional themes emerged from the data analysis for the preferred strategy group: (a) recognizing similarities and relationships among apes presented in the online resources, and (b) believing that time spent in the acquisition and study phases of the experiment was too long.

With regard to the first new theme, students expressed that they recognized similarities in information presented on the five online webpages. All seven (7) students said that they noticed that the webpages contained similar categories regarding weight, family, height, life-span, diet, and social behavior for each ape. Five (5) of the seven (7) students said that once they realized the mutual categories for all the apes, they noticed relationships that existed across categories. When students were asked to provide an example of a relationship, none were able to provide one. Given that the interviews were not conducted immediately after the experiment, it is possible that students did not remember them at the time of the interview.

Students where then asked to explain why they did not write any of the apparent relationships in their study materials. They explained that they: (a) did not see the value of writing relationships in their study materials because they had taken notes that contained all the information they needed in their notepads, (b) believed that memorizing the relationships during the acquisition phase of the experiment was sufficient to answer questions on the immediate achievement test, and (c) did not see the value of purposefully identifying relationships until after the relationship items were presented to them in the achievement test. They explained that if they would have written down relationships that they had noticed, they might have been able to better answer relationship items on the test. One participant said:

> *So I wrote down the name of the ape and then every single thing that I could I found on the site about it. I listed all the facts beneath each ape. For some, I had to think this is the slowest one, this is the fastest one, the medium speed is 30, and the fastest is 50. I saw that the biggest one was the slowest one . . . I didn't think it would it help me to write that stuff down because I had a good summary about each ape. But when I was answering those relationship questions on the test, I thought to myself I probably should have wrote things like largest or tallest ape in my notes and studied them.*

With regard to the second new theme that emerged from the qualitative analysis for the interviews, all seven students expressed that the time spent creating study materials and studying them was too long and unnecessary. One student said:

> *I didn't even need that much time on the sites. I was done taking notes from them pretty quickly. I went over my notes three times and there was still time left before we moved on to the next step. When I realized that I had to spend another 10 minutes studying, I went over my notes one more time, then I just stared at the screen until it was time to take the test. I only needed about 20 minutes to write down everything and review it all.*

Table 10 summarizes and compares the themes that emerged from the qualitative data analysis from the pre-survey, post-survey, and interview. The summary table shows that students from the preferred strategy group were consistent in their descriptions of how they learn from multiple online resources. Considering that the same themes emerged across Rows 2, 3, and 4 in the table, it is apparent that when students where learning from multiple online websites in the experiment, they read the texts on the websites, then they took notes, and then summarized the information and memorized ideas.

The results show that without training in SOAR, students report using some effective study strategies when learning from multiple online resources. Students took notes and summarized information. However, students in this group overlooked effective study strategies such as creating an organizer such as a matrix and regulating their learning by generating test questions. Furthermore, they did not spend time writing relationships in their study materials. Yet, they expressed that the time needed for creating study materials was too long.

SOAR strategy group interview analysis. The SOAR strategy group was asked in one-on-one interviews to describe how they learned from multiple online resources during the acquisition phase of the experiment. The qualitative open-coding data analysis resulted in similar themes to the data analysis from the post survey for that group: (a) taking notes, (b) constructing charts and tables, (c) relating ideas, and d) making test questions. For instance, one participant said:

Table 10

Summary of Themes that Emerged from Pre-survey, Post-survey and Interview for the Preferred Strategy Group (Control)

	Pre-survey	Post-survey	Interview
	Q.8: If you were asked to research a topic or study about a subject matter using multiple online resources, what are all the steps that would you take to learn online? Please be specific in your description of the steps.	Q.3: Please describe in a step by step fashion how you studied the material on Apes. Provide details about the steps you took. Please be specific.	Q.3: Could you please describe in a step by step fashion how you studied the materials on Apes. Provide details about the steps you took. Please be specific.
1	Begin with a search engine	--	--
2	Read information on reliable websites	Read information about Apes in the provided websites	Read information about Apes in the provided websites
3	Take notes from the websites	Take notes in the provided notepads	Take notes in the provided notepads
4	Summarize and memorize information	Summarize and memorize information	Summarize and memorize information
5	--	Recognized that their preferred study strategies were ineffective after taking the test	--
6	--	--	Recognize similarities and relationships between the apes.
7	--	--	Expressed that the length of the acquisition and study phases were too long.

[a] -- = Theme did not emerge from the data analysis for that research instrument.

> *I read through every single website. I started to write down the points that I thought were important. I noticed that there were similarities. All of the pages mentioned age, weight, a specific color, and where they lived. I figured the test would ask about each of these. I used the information to fill out in my organizer. Then I started looking for relationships. I knew it was all right there in the organizer but it was a bit difficult to write them all down. The last thing I did was write a couple test questions*.

An additional theme emerged from the interview. Six of eight students from the SOAR strategy group said that they would have liked more time during the acquisition phase. They explained that creating the organizer was useful but time consuming and that they would have been able to identify more relationships and create more if they had more time. One participant said: "*I didn't have enough time to make relationship questions*." Another said: "*I ran out of time*. *I probably would have made more test questions otherwise*." An additional example was: "*It took me a long time to fill the table with everything, I wanted to write down all of the relationships but by the time I completed my organizer it was too late. I only had enough time to write one or two*."

Table 11 compares and summarizes the themes that emerged from the qualitative analysis for the pre-survey, post-survey, and interview for the SOAR strategy group. The summary table shows the effects of SOAR training on students study strategies when learning from multiple online resources. The only theme consistent across the pre-survey, post-survey, and interviews was taking notes. Following training, students in this group changed their study strategies to include creating an organizer of ideas, identifying relationships, and regulating their learning by creating test questions. Students expressed the need for more time in the acquisition phase to create higher quality study materials.

Table 11

Summary of Themes that Emerged from Pre-survey, Post-survey, and Interview for the SOAR Strategy Group (Experimental)

	Pre-survey	Post-survey	Interview
	Q.8: If you were asked to research a topic or study about a subject matter using multiple online resources, what are all the steps that would you take to learn online? Please be specific in your description of the steps.	Q.3: Please describe in a step by step fashion how you studied the material on Apes. Provide details about the steps you took. Please be specific.	Q.3: Could you please describe in a step by step fashion how you studied the materials on Apes. Provide details about the steps you took. Please be specific.
1	Begin with a search engine	--	--
2	Read information on reliable websites		--
3	Take notes from the websites	Take notes in the provided notepads	Take notes in the provided notepads
4	Summarize and memorize information	--	--
5	--	Create a chart or Table	Create a chart or Table
6	--	Relating ideas to one another	Relate ideas to one another
7	--	Make test questions	Make test questions
			More time needed to create complete study materials.

[a] -- = Theme did not emerge from the data analysis for that research instrument.

Summary

Overall, SOAR trained students scored higher than students using their preferred study strategies on fact, relationship, and concept items as well as total achievement. In addition, students in the SOAR strategy group created better study materials in the

acquisition phase than students in the preferred strategy group. Students in the SOAR group had more organizers in their study materials and their organizers contained a higher number of cells and details. The SOAR strategy group noted more local and global associations and created more fact and relationship questions than the preferred group.

Results of the correlational analysis showed some significant correlations between SOAR components and achievement test item types when learning from multiple online resources. In summary, as the number of idea units and cells in an organizer increased, scores on all three item types increased. In addition, as the number of local and global associations, as well as relationship and fact questions increased, scores on the relationship test increased.

Results show that without SOAR training students reported using several ineffective study strategies. SOAR trained students reported using SOAR strategies to study the online ape texts.

Chapter Five

Discussion

This chapter begins with a general synopsis of the procedures and findings in this mixed methods study. Next certain critical points and themes emerged are discussed. Then, findings from the present study are linked to previous study strategies research. Next, limitations and implications for research are offered along with practical implications. The chapter concludes with some final thoughts.

Synopsis

College students are told that it is important to perform well on tests, but they are seldom taught how to learn and rarely trained in strategies to help them study. Consequently, they use ineffective study strategies with text, lecture, and online materials (Jairam, 2009). One study strategy that proved effective is the SOAR study strategy. SOAR is an acronym for the strategy's four components: select, organize, associate, and regulate.

Two studies found that students who used SOAR achieved higher scores than students who followed their preferred strategies when learning from text (Jairam & Kiewra, 2009) or a computer (Jairam & Kiewra, 2010). A third study found that students who studied using SOAR outperformed students who studied using the popular SQ3R study strategy developed by Robinson (1941). SOAR studiers scored higher than SQ3R studiers on fact, relationship and concept questions (Jairam et al., 2013).

The present study is unique in that it is the first to examine using SOAR for learning from multiple online resources. Additionally, it is the first to examine

exclusively student-generated SOAR materials. In previous studies students were provided with SOAR materials (Jairam & Kiewra, 2009) or contributed to their development (Jairam, 2009).

In the present study, participants gathered in a computer lab and were seated randomly at computers loaded with SOAR or preferred strategy training materials. Following general instructions, participants were asked in a pre-survey to describe how they learn from multiple online resources and if their college instructors ask them to do so. The pre-survey analysis found that students' are not taught how to learn online although they are often asked to do so by their college instructors. The results of the pre-survey showed that without training in how to learn, students use ineffective learning strategies such as rehearsal and memorization when learning online.

Then students advanced to the training phase. The study materials created during training were examined to ensure that the intended experimental effects were followed. The study materials confirmed that students' followed their preferred study strategy or the SOAR study strategy depending on group assignment.

Students next proceeded to the acquisition phase where they were asked to use their trained strategies to learn from multiple online resources in preparation for an achievement test. The study materials created during the acquisition phase were examined to ensure that the intended experimental effects were followed. The study materials confirmed that students' followed their preferred study strategy or the SOAR study strategy again depending group assignment.

Analysis of study materials showed that the SOAR strategy group created better study materials than the preferred strategy group. In particular, they selected more important information, created more organizers containing more idea units, associated ideas by identifying relationships, and regulated their learning by creating test questions. In essence, the SOAR group used all SOAR strategies as trained to do. Most importantly, the SOAR strategy group outperformed the preferred strategy group on all achievement measures: fact, relationship, and concept items as well as total test score.

Following testing, students were surveyed again and asked to describe how they learned the online material. The preferred strategy group used the same strategies to study as they described in the pre-survey. They begin with locating information on credible online resources, take notes, and summarize and memorize information in their study materials. Meanwhile, the SOAR strategy group described using SOAR strategies that they did not mention using when asked in the pre-survey. These results confirm once again that SOAR training positively worked to change the methods that students used to learn.

When asked in the post-survey about their attitudes toward the strategies they used in the acquisition phase, the SOAR strategy group reported that they did not find SOAR more difficult to use than the strategies they commonly use. They found using SOAR effective and enjoyable and one that they would use for future online learning.

In the final step of the experiment, students from both groups were interviewed about the study strategies they used during the acquisition phase. The preferred strategy group reported using the same study strategies they reported in the pre and post survey.

They did not create an organizer containing main ideas, they did not identify relationships in the online texts, and they did not create test questions to regulate their learning, whereas the SOAR strategy group reported that they did all of these things.

Critical Discussion Points and Themes

This section introduces critical points and themes that are especially noteworthy and warrants further discussion.

Relationship items performance. Results showed that SOAR training had its largest effect on students' performance on relationship items, with an effect size of $\eta^2 = .5$. On average, SOAR students scored 70%, whereas preferred students scored 39%. This achievement advantage is not surprising because the analysis of study materials showed that SOAR training had a large effect on the number of local (Cohen's $d = 0.93$) and global (Cohen's $d = 0.87$) associations created when studying the online material. Meanwhile, the correlation analysis found that as the number of local and global associations presented in the students' study materials increased relationship items scores increased. That being said, the average number of local and global associations noted by SOAR students was low. SOAR strategy students created, on average, just two local and one global association in their study materials

When the SOAR strategy group was asked in the post-survey to describe how they learned the online material, *relating ideas to each other* was one of the strong themes that emerged. A closer look at students' answers showed that students identified relationship when studying but chose not to write them down. Students were told in the

acquisition phase that they were studying for an immediate test. Had they been told the test was delayed, then they might have recorded more associations for later review.

Another explanation comes from the quantitative analysis of study materials. Findings showed that as the number of cells in students' organizers increased, relationship item performance also increased. The SOAR group created organizers with a higher number of cells than the preferred strategy group. Perhaps, the SOAR strategy students were learning relationships as they created organizers.

Another explanation stemming from the post-survey is that the SOAR group selected Associate as the least useful SOAR component. Students expressed that there was no need to write down relationships because they already identified them when they created an organizer and believed that writing them was time consuming. It is possible that students identified relationships but simply did not write them down.

Further explanation was provided in interviews. Students expressed they needed more time to create a complete list of relationships. Had students had more study time, they might have generated more relationships in their study materials. Overall, students learning relationships but not writing them in their study materials can be explained by what is called learning-performance distinction (Bouton, 2007). SOAR trained students learned the value of creating associations, and apparently did so mentally, but did not choose to write them down (performance) because doing so seemed repetitive especially when study time was brief.

The issue of time in the acquisition and training phases. Students from both groups were given 30 minutes during the acquisition phase to create study materials

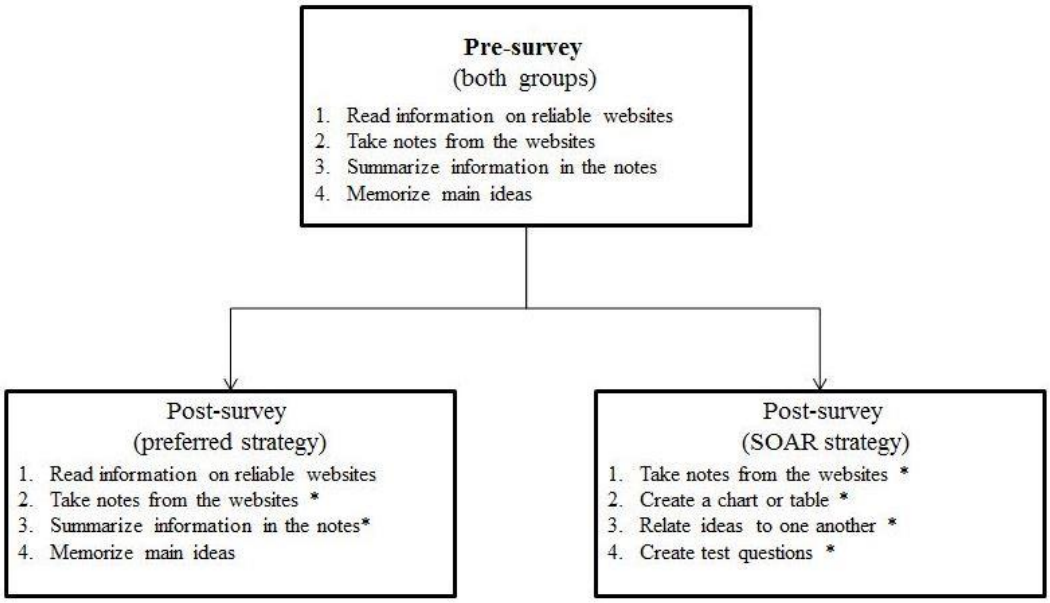
followed by a 10 minute review period. When interviewed, SOAR group students expressed that they would have liked more time to create associations and test items. In comparison, the preferred strategy group expressed that they finished creating study materials and had time to review them during the acquisition phase and found the extra review time unnecessary.

Analysis of students' study materials showed that students in the preferred strategy group took notes but did not create an organizer, identify relationships, or regulate learning. It is possible that they believed that study time was too long because they used fewer strategies than the SOAR group. It was their assumption that writing down ideas in a linear fashion and summarizing them was sufficient to prepare for the test. However, achievement scores clearly showed an advantage for SOAR training and its use. Students in the SOAR strategy group did not stop at taking notes. They used notes to create organizers, associate information, and self-test.

Effects of SOAR training. The prediction that students trained to use SOAR would outperform students trained to use their preferred study strategies in terms of achievement and the quality of study materials created was confirmed. Results of the quantitative analysis showed that SOAR bolstered students learning from multiple online resources.

Yet, the qualitative analysis showed an additional effect SOAR students changed their study behavior when learning from multiple online resources over the course of the experiment. They eliminated the ineffective study strategies that they began with such as rehearsal and memorization and replaced them with effective study strategies such as

creating organizers, relating ideas, and creating test questions. A cross-examination of the qualitative results from the pre- and post-surveys showed how students' study behavior changed over the course of the experiment. Figure 9 compares reported online strategies from both groups in the pre and post surveys..



[a] * = an effective study strategy.

Figure 9. Reported online study strategies.

All students described the same study strategies in the pre-survey: (a) read the information in the provided websites, (b) take notes from the website, (c) summarize information, and (d) memorize main ideas. Two of the four strategies they used are identified in the literature as effective study methods: taking notes and summarizing

information (Atkinson et al., 1999; Baker & Lombardi, 1985; Jairam, 2009; Kiewra, 2004).

The preferred strategy group described the same study strategies in the post-survey. However, the SOAR strategy group changed their study methods to learn from multiple online resources. In the post-survey, the SOAR strategy group reported using SOAR strategies: (a) take notes, (b) create an organizer, (c) relate ideas to each other, and (d) create test questions. They no longer relied on memorization and rehearsal to study from online resources. A brief 30 minute SOAR training period was sufficient to change a lifetime of ineffective study behaviors.

Efficiency in taking notes. Both groups performed comparably in terms of note-taking. However, the SOAR group used somewhat fewer words to describe more idea units. Students in the SOAR strategy group wrote an average of 188 words to describe 59% of the total idea units available in the online texts. Students in the preferred study strategy group used an average of 208 words to describe 52% of the idea units. The correlation analysis resulted in negative correlations between efficiency rating and students performance on the achievement test. Although the relationship strengths were not significant, results indicated that using fewer words to describe an idea unit was related to high performance on the fact, relationship, and concept items.

Perhaps SOAR trained students were slightly more efficient in their note-taking because they were instructed in their training to note main ideas and important details. In addition, they might have been aware of the limited time they had to follow the four steps of SOAR. In this regard, the literature shows discrepant findings. Some researchers found

significant positive correlations between note-taking efficiency and recall (Howe, 1970), while others have not (Aiken, Thomas, & Shennum, 1975).

Linking Previous Research to Present Study

This section discusses how present findings mesh with those from previous studies.

Teaching students how to learn. As stated in the literature review, college students rely on ineffective study strategies while studying (Gubbels, 1999; Kiewra & DuBois, 1991; Rachal et al., 2007). It is possible that college students are weak studiers because they were not taught how to learn (Kiewra, 2004). For example, Durken (1978) observed reading and social studies instruction and found that teachers did not instruct students on comprehension. Zimmerman et al. (1996) reported that instructors rarely prepare their students for how to learn and spend less than 10% of instruction time training study strategies. Students were not taught methods for carrying out complex tasks, or study strategies like self-examining their learning.

Students in the present study reported that the same is true for learning from online resources at the college level. In fact, 72% of students in the present study reported that they were asked to learn from online resources without instructions on study strategies to help them learn. However, this study showed that with only 30 minutes of training in SOAR, students used effective study strategies and scored higher on fact, relationship, and concept items than students using their preferred ineffective study methods.

Preparing college students on how to best learn from online resources is valuable because students' computer use has increased in the past 2 decades (Pugh, Pawan, & Antommarchi, 2000), and it is well established that college students rely on Internet resources when preparing for a test (Dilevko & Gottlieb, 2002; Metzger et al., 2003; Rieh & Hilligoss, 2008; Selwyn, 2008).

Reported study strategies with multiple online resources. Previous research found that students use ineffective study strategies when learning from course materials (Gubbels, 1999; Kiewra, 1985b; Pressley et al., 1997), online prose (Jairam, 2009), and computer-based materials (Jairam & Kiewra, 2010). Those ineffective strategies include taking incomplete notes, organizing information in a linear or bulleted form, learning in a piecemeal fashion, and using redundant strategies such as memorization and rehearsal. The present study confirmed that most of the same ineffective strategies were used when students learned from multiple online resources with minor differences discussed next.

Table 14 (see Appendix K.1) compares students' reported study strategies in the present study when learning from multiple online resources with Jairam's (2009) study on learning from online prose and Jairam and Kiewra's (2010) study on learning from computer-based materials.

The ineffective study strategies reported in Table 12 show that in all three studies students left to their own devices use weak study strategies whether information is presented in the form of printed text, a single text on a computer, or multiple online resources. Students created incomplete notes, failed to create organizers (although they

Table 12

Reported Study Strategies for Online Prose, Computer-based, and Online Materials

Online prose	Computer-based	Online resources
Incomplete notes and highlighting	Incomplete notes, highlighting, copy-paste chunks of text	Incomplete notes
Linear notes	Linear notes	Linear notes
Piecemeal Learning	Piecemeal Learning	Piecemeal Learning
Redundant strategies	Redundant strategies	Redundant strategies, rehearsal, and memorization

were given comparative material to learn) failed to associate information, and failed to regulate learning.

The only difference was that in the present study students in the preferred strategy group created more complete notes than students in previous studies. Perhaps, the preferred strategy students in the present study created more complete notes because they were restricted to taking notes on notepads and thus spent time and effort identifying main ideas. In Jairam and Kiewra's (2010) study, students created their study materials on a computer and therefore were able to copy and paste text and did not attempt to identify key points. Students who copy and paste in an unrestricted manner learn less than students who are selective of ideas to include in their study materials (Igo et al., 2005). In addition, students in the present study took notes from five resources whereas in the two previous studies they took notes from a single source. The larger number of resources could have prompted students to create more complete notes.

The ineffective strategies reported in the present study were similar to the two previous SOAR studies (Jairam, 2009; Jairam & Kiewra, 2010) and others (Aharony, 2006; Bausch & Becker, 2001; Concannon, Flynn, & Campbell, 2005; Gubbels, 1999; Jairam, 2009).

SOAR study strategy for learning from multiple online resources. The present study examined the effects of SOAR on students' learning of facts, relationships, and concepts when learning from multiple online resources. Previous studies examined the effect of SOAR training on students' performance on fact and relationship items when learning from printed text (Jairam & Kiewra, 2009) and single online text (Jairam & Kiewra, 2010). SOAR trained students in all three studies outperformed students who used their preferred study strategies on facts and relationships. Table 13 compares the effect sizes for the three studies on fact, concept, and relationship learning for students who studied using SOAR.

Table 13

Comparison of Effect Sizes of SOAR Trained Students' Performance on Fact and Relationship Items when Learning from Traditional Prose, Online Prose, and Multiple Online Resources

	Printed text	Online prose	Multiple online resources
Fact	.19	.25	.06
Relationship	.37	.58	.50
Concept	-	-	.05

In terms of fact learning, the effect size (.06) in the present study was less than the effect sizes for traditional prose (.19) and online prose (.25). With regards to relationship learning, the effect size (.50) was higher than the effect size for traditional prose (.37) and lower than the effect size for online prose (.58). The present study adds to the literature in that SOAR trained students outperformed preferred strategy students on concept items (.05). The two previous studies on SOAR did not examine students' learning of concepts.

Two factors might have influenced effect size differences among the three studies. First, perhaps the effect size for fact items in the present study was less than the two previous studies because SOAR students in the previous studies were provided with instructor-generated materials containing a complete set of notes or were assisted in creating complete notes. Students in the present study were responsible for selecting information and identifying main ideas on their own and therefore created fewer notes than would have been available to them in previous studies. Furthermore, it is probable that the relationship effect size in the present study was less than the online prose study because SOAR students in the previous study were provided with an organizer whereas SOAR students in the present study created their own.

Second, it is possible that the relationship items effect size in the present study was less than in Jairam and Kiewra's (2010) study because students in that study were presented with only one text containing comparative content. In the present study, students were selecting information across five available resources. The larger number of recourses could have made it more difficult to identify associations across texts. Similarly, it is possible that fact items effect size in the present study was less than the two previous

studies because the number of ideas presented in the five texts was higher, making it more difficult to create a complete set of notes.

In retrospect, the findings in this study support previous findings that SOAR training assists students in learning facts and relationships and expands upon Jairam and Kiewra's (2009, 2010) studies in that students relied on their training to generate their study materials and they studied from multiple online resources and in that the present study examined concept learning and found that SOAR trained students also outperform preferred strategy students.

Limitations and Research Implications

This study has eight methodological limitations due to research design, data collecting procedures, and logistics of conducting the experiment.

Limitations due to research design. Students in both groups were given the same amount of time in the acquisition phase (30 minutes) and the study phase (10 minutes). Students were not allowed to advance at their own pace. As a result, students in the preferred strategy group expressed that study time was too long whereas the SOAR strategy group expressed that they needed more time to identify relationships and generate test questions. Future research studies could introduce flexibility study times and determine if there are group differences.

The second design limitation was the limited number of online resources provided. Students had access to only five online resources. In the pre-survey, students reported that they commonly rely on three to four websites when learning online. However, it is possible that the number of resources that students use might change if there is no limit.

In a future study, students could be given the option to locate and use any online resources from the web.

The third design limitation was that students were tested on the online material only one hour after the training phase. The long-term effect of SOAR training was not investigated. In a future study, students could be tested twice: first shortly after training and then several days later.

The fourth design limitation was the quality of the resources provided. In this study, information provided on the webpages was accurate. Although students expressed the importance of evaluating the reliability of information on websites, they might select resources from the web with contradicting or inaccurate information. A future study could investigate if SOAR training can assist students in identifying accurate from inaccurate information when webpages are of mixed quality.

The final design limitation was training the SOAR group on all four components of SOAR. A future study could investigate effects of the individual SOAR components on students' learning from multiple online resources. Students could be divided into four groups and trained on either: S (select), SO (select and organize), SOA (select, organize, and associate), or SOAR (select, organize, associate, and regulate) as was done in studies by Jairam and Kiewra (2009, 2010).

Limitations due to logistics. Cronbach alpha was used to measure the squared correlation between observed scores and true scores for the achievement test and for item types. The overall calculated reliability for the achievement test was high at .80. However, the separate reliabilities for individual item types were low. Cronbach alpha was .40 for

concept items, .50 for fact items, and .71 for relationship items. George and Mallery (2003) rate a .70 reliability as acceptable. In part, the low reliabilities might be due to the total number of items on the test. For logistical reasons, the test contained only 25 items: 5 concept, 10 relationship, and 10 fact. The internal consistency of items in the scale could increase to .80 or higher if more questions were used. Future studies could introduce more items in the achievement test to increase overall reliability and increase internal consistency the item types.

The second logistical limitation was the brief length of the research intervention. The experiment was conducted over the course of two hours. Thus, findings from this study might not generalize to treatments with a different treatment length. Future studies might, for example, investigate the effects of SOAR training over the length of an academic semester.

Practical Applications

Findings showed that when college students are not taught how to learn, they use ineffective study strategies when learning from multiple online resources, but that SOAR training resulted in better study materials and higher achievement than preferred strategies when learning from multiple online resources. With SOAR training, students created quality study materials by selecting important information, creating a detailed organizer that organized information by topics and categories, generating associations that showcased local and global relationships, and regulating learning by generating fact and relationship questions.

Findings have practical applications for instructors, college students, and instructional design and technology specialists. The learning benefits of SOAR found in this study are valuable to instructors because they show that learning can be improved with brief training. Instructors should introduce SOAR training in classes or provide students with self-paced online SOAR training similar to that used in this study. The online SOAR training in this study was created using a mix of HTML, CSS, and Javascript web languages. If instructors do not have the necessary technical skills to develop training using similar web languages, it is possible to replicate the training in this study using more common desktop software packages such as Microsoft PowerPoint or web based applications like Prezi or Storyboardthat.

College students are encouraged to change the way they learn from online resources. They should replace ineffective study methods like rehearsal and memorization with effective study methods like SOAR that can enhance learning. SOAR can assist them when learning from multiple online resources and help them create quality study materials. Studying from quality study materials will help students' learn facts, relationships, and concepts.

Instructional design and technology specialists are encouraged to create self-paced online SOAR training materials embedded in the learning management system used at their higher education institutions. Even if college instructors choose not to spend time teaching students effective learning strategies, instructionally designed online SOAR training could provide an applicable solution to the weak study strategies that students typically use to learn from multiple online resources. Because college students are willing

to voluntarily use online study tools to become better prepared for tests (Grabe & Sigler, 2002), it is likely that they will voluntarily engage in SOAR training if told about its impressive advantages over preferred strategies as told throughout this dissertation.

Conclusions

In conclusion, when left to their own devices college students do not study effectively when learning from multiple online resources. They create incomplete study materials focusing on single facts and they fail to organize, associate, and regulate noted ideas. Students need to address these issues promptly given that over two thirds of students in this study reported that they are often asked by college instructors to learn information online without instruction on effective study practices.

Fortunately, findings showed that students trained in SOAR created quality study materials and achieved more on fact, concept, and relationship items than students using their preferred study strategies. SOAR has shown benefits in past research for learning facts and relationships from text and on a computer. This study adds to the emerging literature demonstrating the effectiveness of SOAR over students' preferred study strategy for online learning resources.

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Appendix A

Pre-Survey

Pre-survey

This questionnaire is a part of a research project aimed to understand students' learning from multiple online resources. Please read each question carefully before you answer it by checking the appropriate response box. This will take approximately 3-4 minutes.

1. Please provide your assigned 5 digit number in the text below. This number should be located on the first page of the note pad given to you.

2. Please state your sex:
   - Male
   - Female

3. Please state your age range:
   - 19 to 20
   - 21 to 22
   - 22 and Over
   - Decline to answer

4. What year of college are you in:
   - Freshmen
   - Sophomore
   - Junior
   - Senior

5. Have you ever participated in any of the following the courses:
   - EDPS 209
   - EDPS 362
   - EDPS 855
   - Did not participate in any of the courses mentioned above.

6. Are you familiar with the SOAR study method?
   - Yes
   - No

If you answered **YES** to this question please answer the following **two** questions:

6.a Please explain how you became familiar with the SOAR study method in the text box below:

6.b Have you ever used the SOAR study method to assist you in studying online materials?

- Yes
- No

7. Have you been asked by any of your college instructors to use the Internet to independently learn about a topic introduced in class?
   - Yes
   - No

If you answered **YES** to this question, please answer the following question:

7.a Did the instructor provide you with a study method to assist you when learning online?

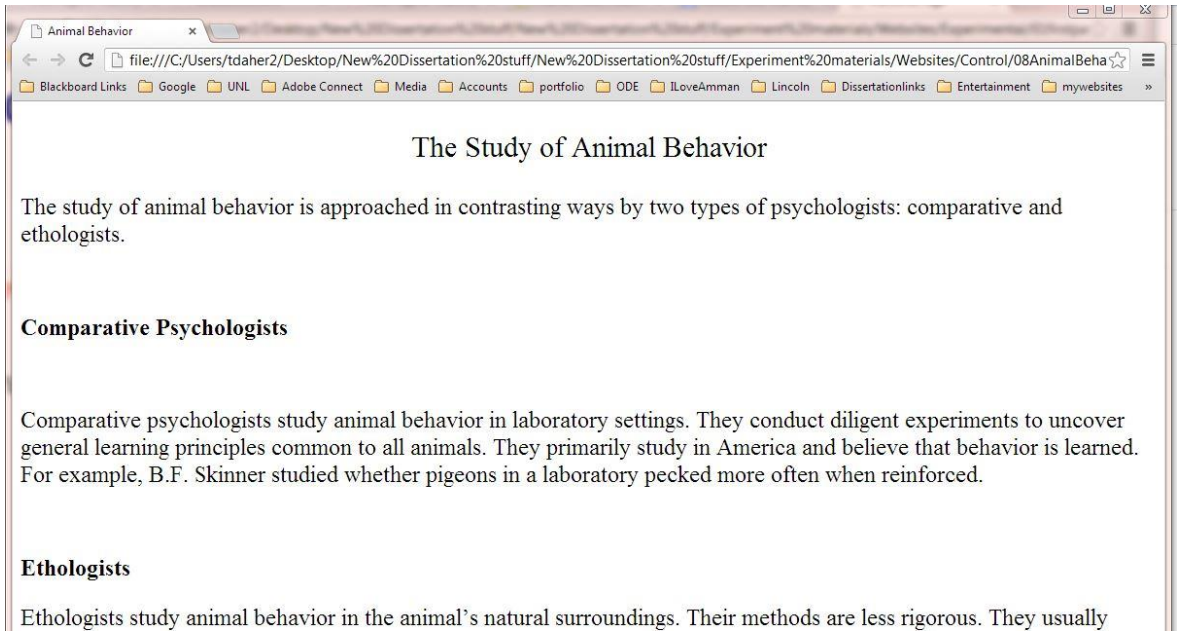
- Yes
- No

8. If you were asked to research a topic or study about a subject matter using multiple online resources, what are all the steps that would you take to learn online? Please be specific in your description of the steps.

Appendix B.1

Snapshot of Training (Control Group)

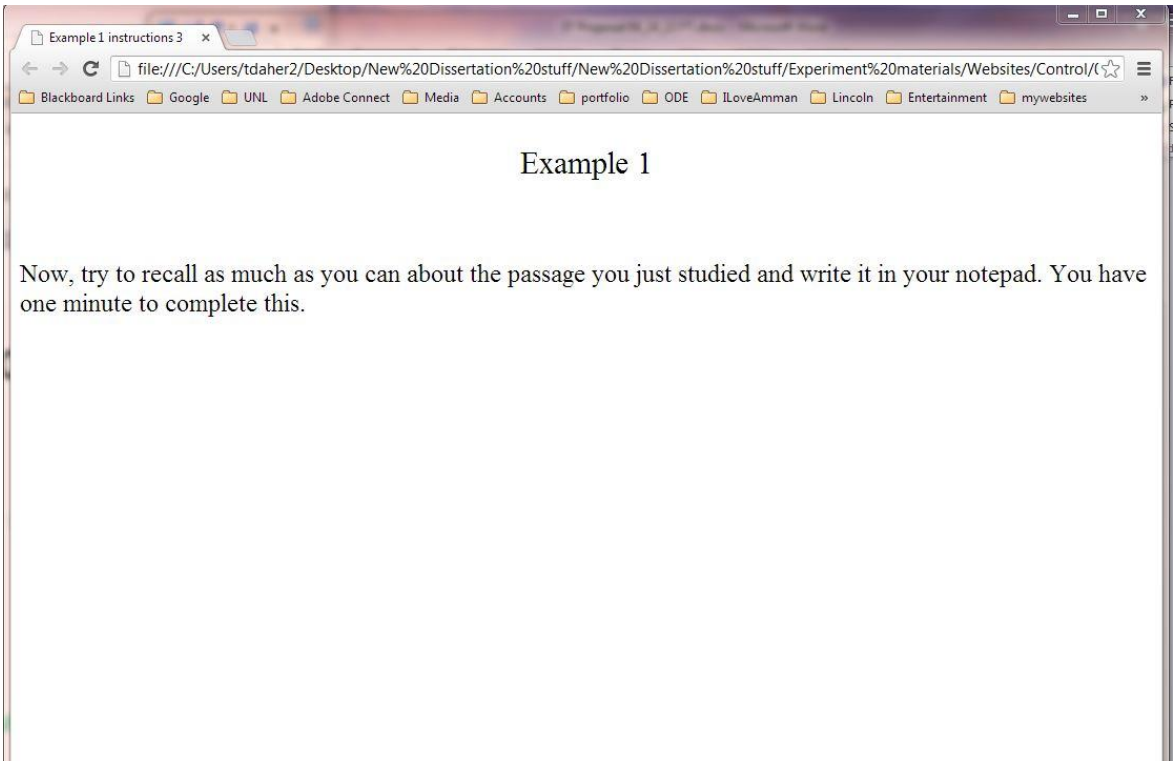
Snapshot of training (control group)



Appendix B.2

Snapshot of Training (Control Group)

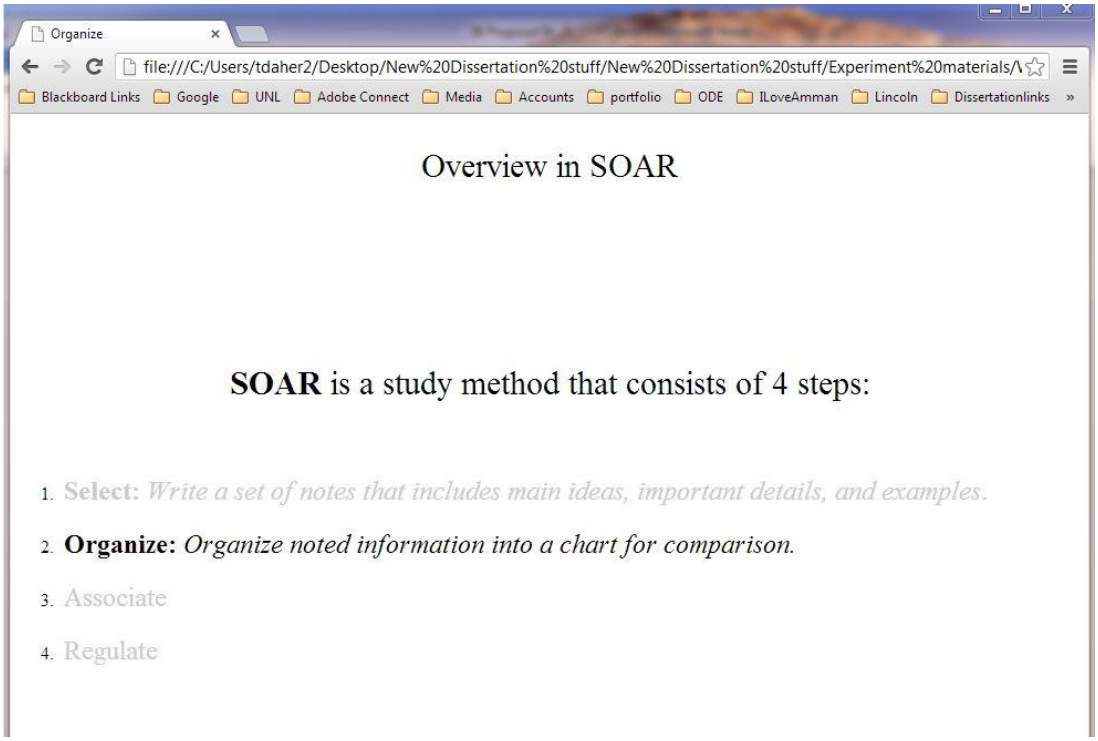
Snapshot of training (control group)



Appendix B.3

Snapshot of Training (Experimental Group)

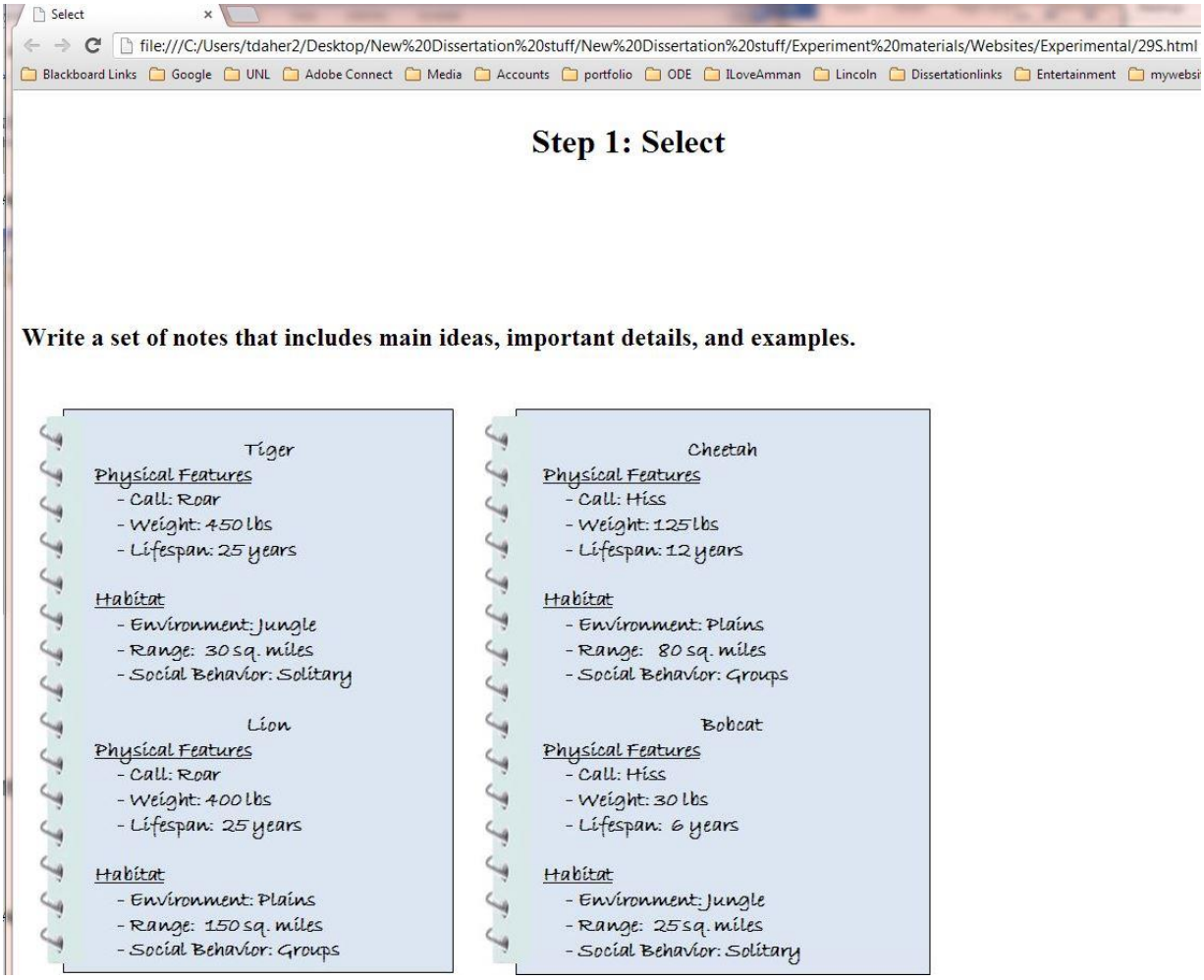
Snapshot of training (experimental group)



Appendix B.4

Snapshot of Training (Experimental Group)

Snapshot of training (experimental group)



Appendix B.5

Training Text Number One (Symbiosis)

Training text number one (symbiosis)

Symbiosis

Symbiosis is defined as a situation in which two living organisms live together in a close nutritional relationship.

There are three different types of symbiosis:

Commensalism

A type of symbiosis where one organism benefits and the other is unaffected, such as a barnacle on a whale.

Mutualism

A type of symbiosis where both organisms benefit, such as a flower and a honeybee.

Parasitism

A type of symbiosis where one organism benefits and the other is harmed, such as a tick on a dog.

Appendix B.6

Training Text Two (The Study of Animal Behavior)

Training text two (the study of animal behavior)

The Study of Animal Behavior

The study of animal behavior is approached in contrasting ways by two types of psychologists: comparative and ethologists.

Comparative Psychologists

Comparative psychologists study animal behavior in laboratory settings. They conduct diligent experiments to uncover general learning principles common to all animals. They primarily study in America and believe that behavior is learned. For example, B.F. Skinner studied whether pigeons in a laboratory pecked more often when reinforced.

Ethologists

Ethologists study animal behavior in the animal's natural surroundings. Their methods are less rigorous. They usually observe animals. They primarily study in Europe and believe that behavior is innate. For example, Charles Darwin studied the behavior of sea turtles on the Galapagos Islands.

Appendix B.7

Training Text Three (Wildcats)

Training text three (wildcats)

Wildcats

No doubt you've seen caged cats in zoos. But what are they really like in their natural habitats? This text discusses four specific wildcats: tigers, lions, cheetahs, and bobcats. Each cat is discussed in terms of its physical features and lifestyle.

The Tiger

Physical Features

The tiger's physical features are striking. The tiger's most common call is a ferocious roar that sends other creatures scurrying. Another telltale feature is the tiger's weight. The full-grown tiger can weigh up to 450 pounds. Its life span is roughly 25 years.

Lifestyle

Next, consider the tiger's life style. Although capable of living in many locations, a tiger prefers the jungle habitat. It spends most of its time on the fringes, although it sometimes travels deep into the heart of the jungle. Within the confines of its habitat, the tiger's social behavior can best be described as solitary. The tiger avoids other tigers except during mating season. After mating, a tiger again returns to its solitary life style. The tiger's habitat is within a range of approximately 30 square miles. It spends its entire life within the confines of that area.

The Lion

Physical Features

A description of the lion's physical features must begin with its mighty roar. The echo of the lion's roar has reminded many people of the sound of thunder from an approaching storm, and it can be heard from miles away. A full-grown lion in the wild has a maximum weight of 400 pounds. The lion typically lives about 25 years in the wild.

Lifestyle

Regarding the lion's life style, it lives on the plains where tall grass and sporadic trees give it protection from the hot afternoon sun. Lions have predicTable social behavior. They live in groups ranging in size from four to 40 lions. One male is usually considered the dominant lion because he is in charge of other males, females, and lion cubs. The lion has a range of approximately 150 square miles.

The Cheetah

Physical Features

The cheetah's primary call is a hiss, much like that of a common house cat. A full-grown cheetah has a maximum weight of 125 pounds. It has a life span of eight years.

Lifestyle

A cheetah lives on the plains. Cheetahs spend their entire life within this area. From the day they are born, cheetahs live in small groups consisting of siblings and

others of approximately the same age. Cheetahs have a range of approximately 50 square miles.

The Bobcat

Physical Features

Although the bobcat is capable of making many different vocalizations, its primary call is the hiss. A full-grown bobcat has a maximum weight of 30 pounds. The average life span of the bobcat is typically six years in the wild.

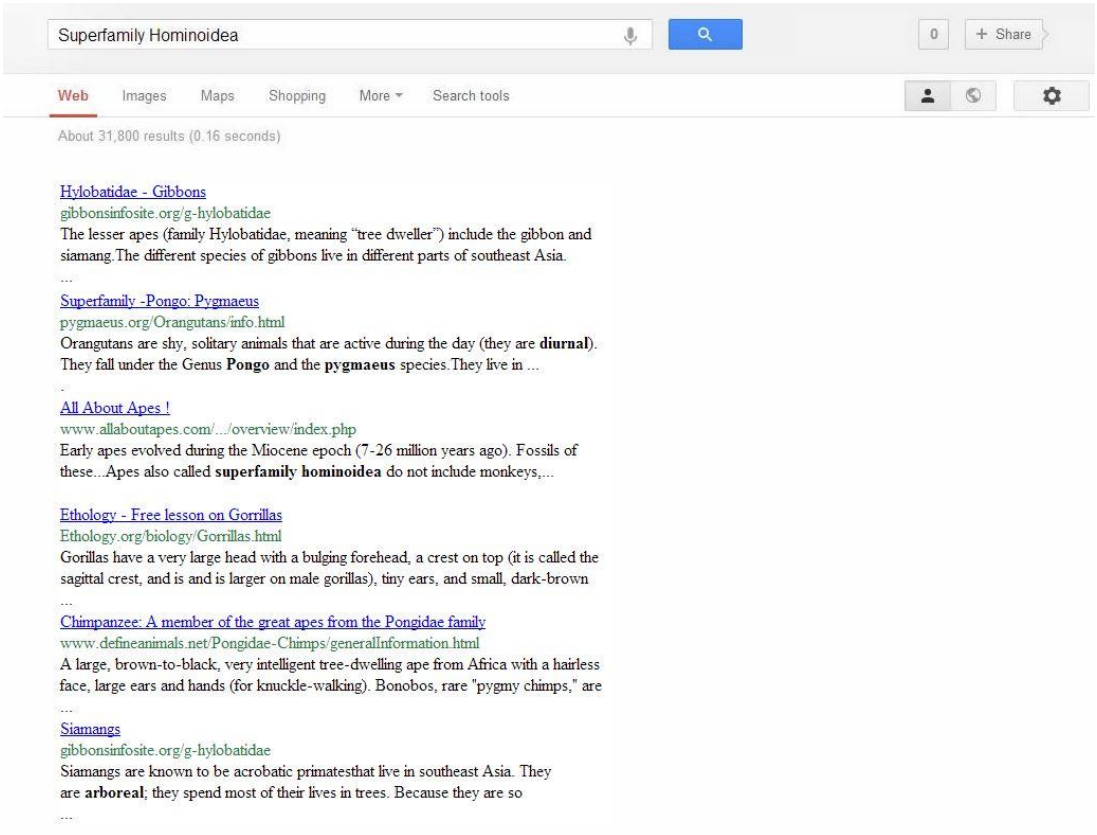
Lifestyle

The bobcat's habitat is the jungle region. It spends its life traveling within this area. The bobcat's social behavior is solitary. This means that it rarely spends time interacting with other bobcats. The only time it does interact with others is during mating season. Its range is about 25 square miles.

Appendix C.1

Website Example

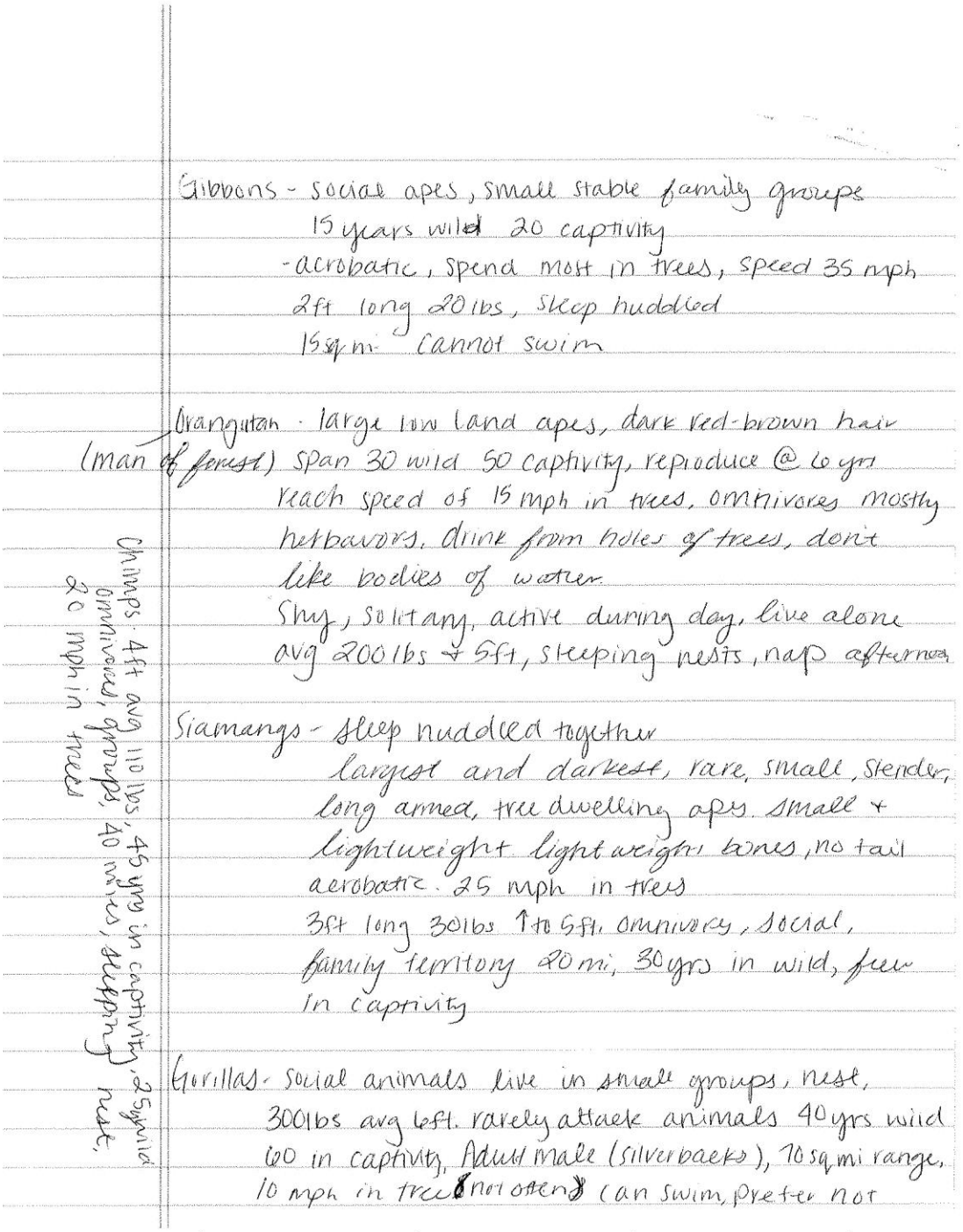
Website example



Appendix C.2

Student Notes Sample (Control)

Student notes sample (control)



Gibbons - social apes, small stable family groups
15 years wild 20 captivity
- acrobatic, spend most in trees, speed 35 mph
2ft long 20lbs, sleep huddled
15 sq mi cannot swim

Orangutan - large tree land apes, dark red-brown hair
(man of forest) span 30 wild 50 captivity, reproduce @ 6 yrs
reach speed of 15 mph in trees, omnivores mostly herbavors, drink from holes of trees, don't like bodies of water
Shy, solitary, active during day, live alone
avg 200lbs & 5ft, sleeping nests, nap afternoon

Siamangs - sleep huddled together
largest and darkest, rare, small, slender, long armed, tree dwelling apes. small & lightweight light weight bones, no tail
aerobatic. 25 mph in trees
3ft long 30lbs ↑ to 5ft. omnivory, social, family territory 20mi, 30yrs in wild, few in captivity

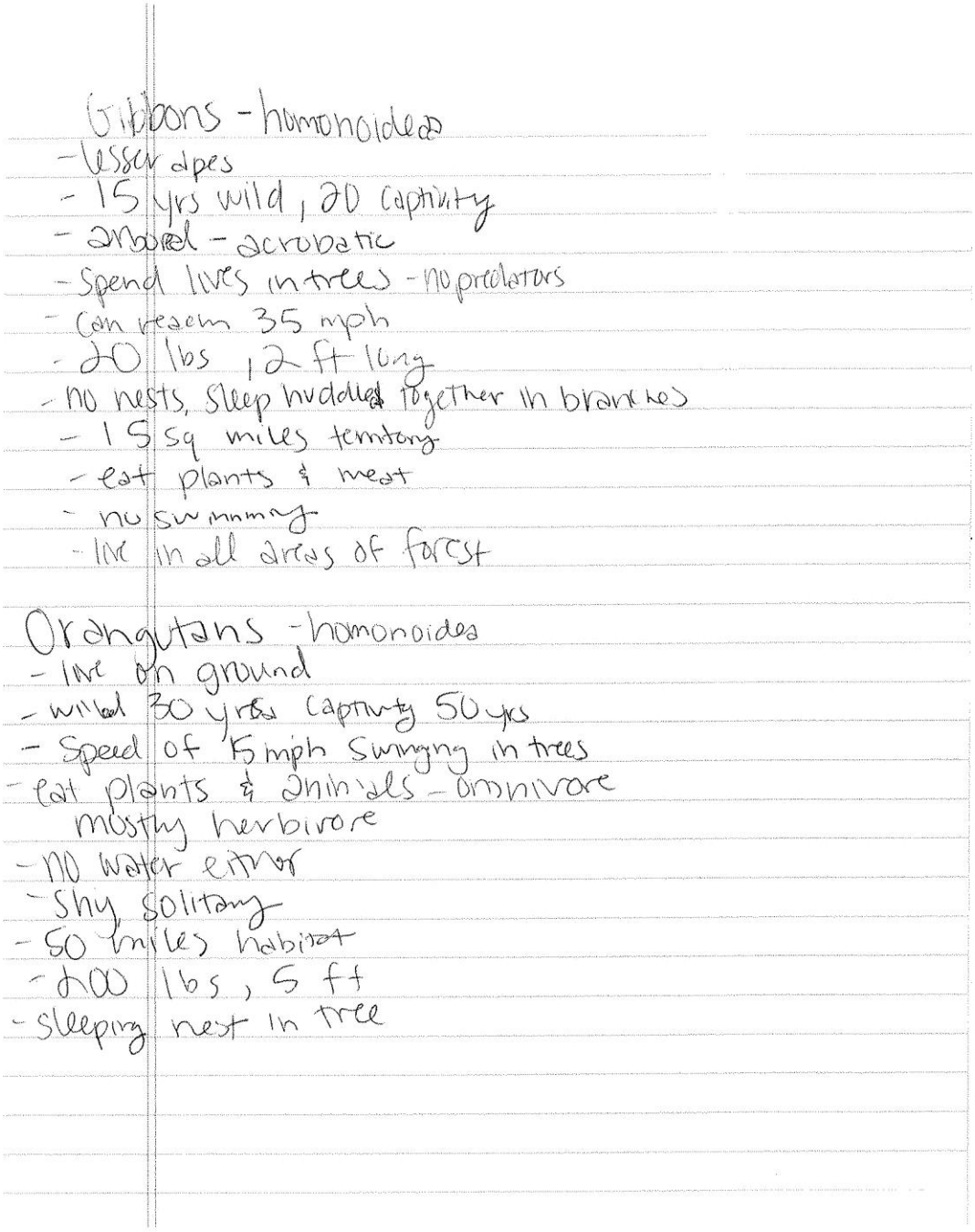
Gorillas - social animals live in small groups, nest,
300lbs avg 6ft. rarely attack animals 40yrs wild
60 in captivity, Adult male (silverbacks), 10 sq mi range,
10 mph in tree (not often) (can swim, prefer not

Chimps - 4ft avg 110 lbs, 45 yrs in captivity, 25 sq mi
omnivorous, groups, 40 miles, sleeping nest,
20 mph in trees

Appendix C.3

Student Notes Sample (Experimental)

Student notes sample (experimental)

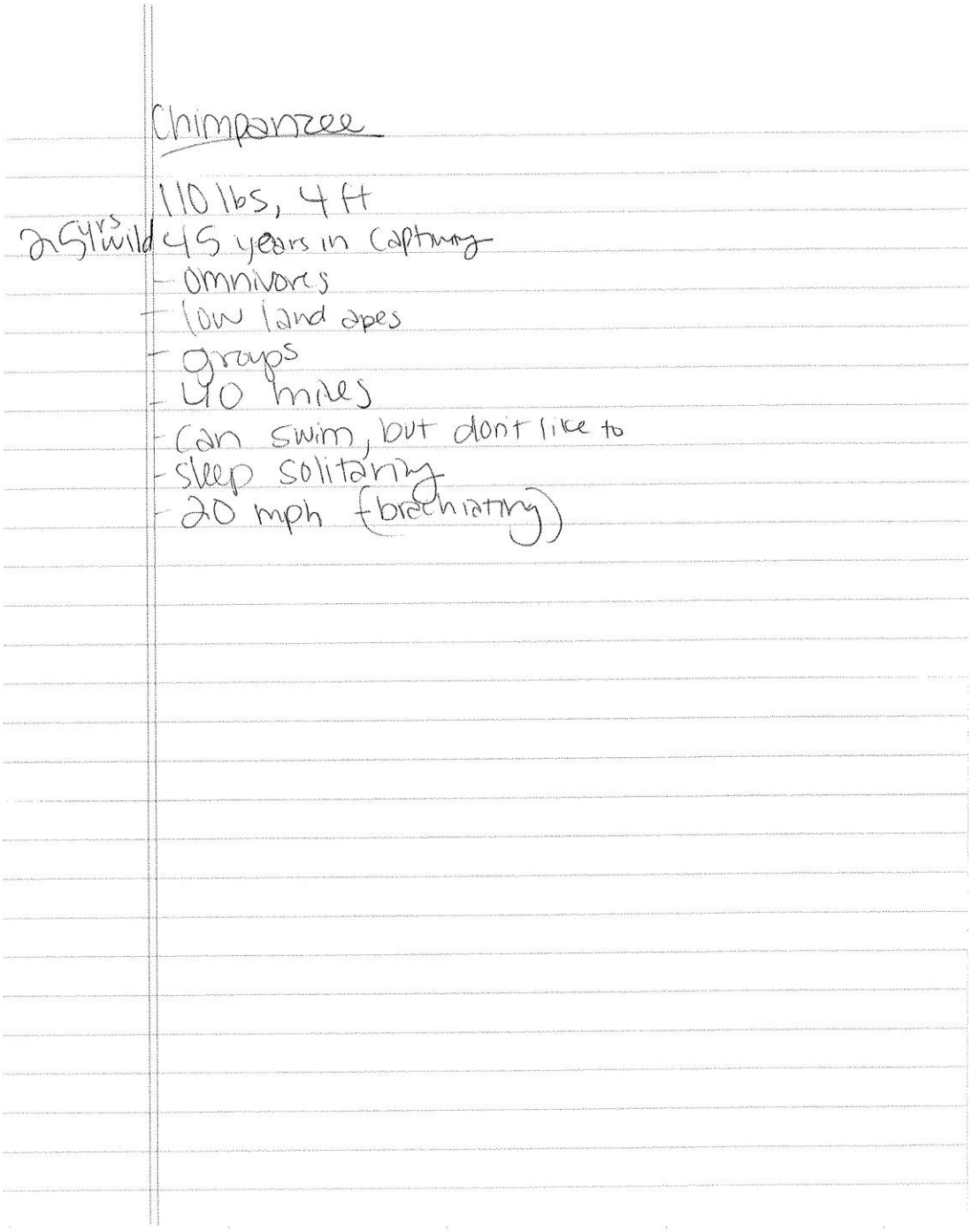


Gibbons - homonoidea
- lesser apes
- 15 yrs wild, 20 captivity
- arboreal - acrobatic
- spend lives in trees - no predators
- can reach 35 mph
- 20 lbs, 2 ft long
- no nests, sleep huddled together in branches
- 15 sq miles territory
- eat plants & meat
- no swimming
- live in all areas of forest

Orangutans - homonoidea
- live on ground
- wild 30 yrs captivity 50 yrs
- speed of 15 mph swinging in trees
- eat plants & animals - omnivore mostly herbivore
- no water either
- shy solitary
- 50 miles habitat
- 200 lbs, 5 ft
- sleeping nest in tree

Siamangs
- tree-dwelling
- small, rare
- lightweight
- live in trees (arboral)
- 25 mph
- 3.5 ft, 30 lbs
- omnivore
- no water
- small stable family group living
- 20 miles rain forest
- 30 years in wild, only a few in captivity
- huddle together - no nest

Gorillas
- social, small groups
- nests
- 300 lbs, 6 ft
- 40 yrs wild, 60 yrs captivity
- herbivores
- ground animals
  - 70 mile range
  - 10 mph
  - can swim, but do not like to


Chimpanzee
110 lbs, 4 ft
25yrs wild 45 years in captivity
- Omnivores
- low land apes
- groups
- 40 miles
- can swim, but don't like to
- sleep solitary
- 20 mph (brachiating)

	Gibbons	Orangutans	Siamangs	Gorillas	Chimp
life in wild	15	30	30	40	25
life captivity	20	50	few	60	45
habitat	trees	ground	trees	ground	50/50
brachiating mph	35	15 mph	25	10	20
weight (lbs)	20	200	30	300	110
height (ft)	2 ft	5	3-5	6	4
sleeping	huddled together in trees	nest	huddle, no nest	nest	nest in trees solitary
miles habitat	15	50	20	70	40
eating	omnivore	omnivore	omnivore	herbivore	omnivore
	we all hate to swim →				
social standing	groups	solitary	groups	groups	groups

The bigger the ape the larger the habitat space.

All do better in captivity except Siamangs.

Bigger apes live on ground while lighter apes prefer trees w/ no predators

lighter apes swing faster thru trees
large apes: 10-15 mph small apes: 25-35

Orangutans are the only solitary ape

All omnivors except Gorillas

The larger the gorilla the longer its lifespan.

which apes live on the grand?
gorillas, orangutans

which apes live in trees?
siamangs, gibbons, chimps 5/50

Which apes are closest to humans?
Chimps

What are the apes sleeping habits?
gibbons & siamangs huddle together in trees
Orangutans nest alone
gorillas nest together
Chimps nest alone but are social in the day time

Which apes are similar & which are different?

The smaller apes - gibbons & siamangs act the same whereas the larger apes act similarly also. the only difference is gorillas are social & orangutans are NOT & chimps seem to always be in the middle.

gibbons & siamangs : 20-30 lbs
gorillas & Or. 200-300
chimps : 100

are able to?

Bigger apes Probably have adapted to live on the ground because they are large & can scare predators

the small apes like gibbons & siamangs have adapted to only trees because they are small & wherable & can only live where there are not predators

Appendix D

Quantitative Instrument – Achievement Test

Quantitative instrument – achievement test

The Achievement test began with the following questions:

Q1. Please provide your first and last name in the text box below

Q2. Please provide a current email address in the text box below

Q3. Please state the 5 digit number assigned to you in the textbox below. This number is located on the first page of your note-pad.

Appendix D.1

CI (Concept Items)

Appendix D.1 – CI (concept items)

* * Note: *Answers to concept questions appear below in **bold** print.*

You will be presented with a scenario. All questions in this section of the test are related to this scenario. Please select the correct answer from the choices available to you.

Scenario: A group of researchers, biology professors and students from the University of Nebraska-Lincoln take a trip to learn about the world of apes. They travel to a different continent to visit a natural conservatory of apes. A biologist in charge of the conservatory offers to take them to explore the area.

Q1. It was morning when they arrived and they heard a loud noise coming from the forest. It sounded like screeching or squealing. It was obvious that it came from several apes at once. The apes they were hearing were from the

a. Genus Hylobates
b. Genus Pongo
c. Genus Gorilla
d. Genus Pan
e. Genus Homo

Q2. As they headed further in the conservatory, they noticed a round area made out of different parts of trees. It was located high in tree between tree branches and was shaped like a cave. This area was quite large and spacious and occupied by one ape. The biologist explained that this area was occupied by

a. a Gorilla
b. a Chimpanzee
c. a Gibbon
d. an Orangutan
e. a Siamang

Q3. They headed into the forest and noticed a predator trying to hunt down an ape. The ape was swinging from on tree to another quickly and gracefully. The ape was dark, small and had arms longer than his legs. The ape they saw was from the

a. Genus Hylobates
b. Genus Pongo
c. Genus Gorilla
d. Genus Pan

e. Genus Homo

Q4. They decide to take a break from hiking and they noticed an ape had captured two robins to eat. This medium sized ape carried one robin in each hand and walked away from them on both her legs. The ape they saw was from the

a. Genus Hylobates
b. Genus Pongo
c. Genus Gorilla
d. Genus Pan
e. Genus Homo

Q5. As their journey came to a finish they saw a group of apes using sticks to kill insects and eat them. These apes were

a. Gorillas
b. Chimpanzees
c. Gibbons
d. Orangutans
e. Siamangs

Appendix D.2

RI (Relationship Item)

RI (relationship items)

Instructions:

Relationship Questions

The following questions will ask you about the relationships that you may have noticed in the online text about Apes that you read. Relationships can relate one characteristic about the things involved to another characteristic, such as "**Planets closer to the sun have hotter temperatures; whereas planets further from the sun have colder temperatures**." The relationships may also relate several characteristics about a group of things, such as, "**Planets closer to the sun have hotter surface temperatures and rockier surfaces, compared to planets further from the sun with colder temperatures and slushy surfaces."** Also, please make your answers complete to fully describe the relationship. For example, a researcher found that in a particular city, 100% of men are republican and 100% of women are democrat. If you were asked to report the relationship above, it would not be complete to only say "**all men in the city are republican**." Rather, a complete "**all men in the city are republican and all women are democrat**".

* * Note: *Answers to relationship questions appear below the questions in **italic bold** print.*

Q1. What is the range in height for all 5 apes?

All apes range between 2 to 6 ft in height.

Q2. What is the range in life span in the wild for all 5 apes?

All apes live between 5 to 40 years in the wild.

Q3. How many of the 5 apes are Omnivores?

4 of the 5 apes are Omnivores.

Q4. How many of the 5 apes swim?

3 of the 5 apes swim

Q5. How many of the 5 apes have dark colored skin?

4 of the five apes have dark colored skin

Q6. What is the relationship of an apes' life span in wild and weight?

The more an ape weighs the longer the life span.

Q7. What is the relationship between an apes' speed in trees and weight?

The more an ape weighs the slower s/he can swing in the trees.

Q8. What is the relationship between an apes who create sleeping nests and swimming ability?

Apes that sleep in sleeping nests can swim

Q9. What is the relationship between an apes' Family and their defense mechanism?

All of the greater apes gather in groups and make noise when attacked. All of the lesser apes brachiate away.

Q10. What is the relationship between apes' Family and creating sleeping nests?

Apes from the Greater Ape family create sleeping nest. Apes from the lesser apes do not.

Appendix D.3

FI (Fact Item)

FI (fact items)

Fact questions

Instructions

The following questions will test your memory for previously presented information on apes.

* Note: *Answers to fact questions appear in **bold** print.*

Q1. Which ape can move fastest in trees?
a. Gorilla
b. Chimpanzee
c. Gibbon
d. Orangutan
e. Siamang

Q2. Which ape does the worst when living in captivity?
a. Gorilla
b. Chimpanzee
c. Gibbon
d. Orangutan
e. Siamang

Q3. Which ape isd the closest genetically to humans?
a. Gorilla
b. Chimpanzee
c. Gibbon
d. Orangutan
e. Siamang

Q4. Which ape has an inflaTable throat sac?
a. Gorilla
b. Chimpanzee
c. Gibbon
d. Orangutan
e. Siamang

Q5. Which male ape weighs about 200 lbs?
a. Gorilla
b. Chimpanzee

c. Gibbon
d. Orangutan
e. Siamang

Q6. Which ape is known for using tools both in captivity and the wild?
a. Gorilla
b. Chimpanzee
c. Gibbon
d. Orangutan
e. Siamang

Q7. Which ape reproduces at a young age of 6 years?
a. Gorilla
b. Chimpanzee
c. Gibbon
d. Orangutan
e. Siamang

Q8. Which male ape has a patch of silver hair on his back?
a. Gorilla
b. Chimpanzee
c. Gibbon
d. Orangutan
e. Siamang

Q9. Which ape belongs to the genus Pan?
a. Gorilla
b. Chimpanzee
c. Gibbon
d. Orangutan
e. Siamang

Q10. Which ape knuckle-walks?
a. Gorilla
b. Chimpanzee
c. Gibbon
d. Orangutan
e. Siamang

Appendix E.1

Post Survey (Control)

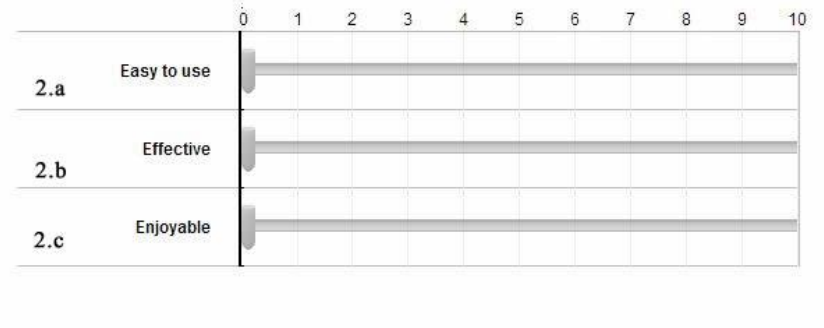
Post Survey (control)

1. Please provide the number assigned to you. This number is located on the first page of your notepad.

2. (Questions 2.a- 2.c)

   Please rate each of the items below, where "0" is Strongly Disagree and "10" is Strongly Agree. Select your rating by sliding the bar.

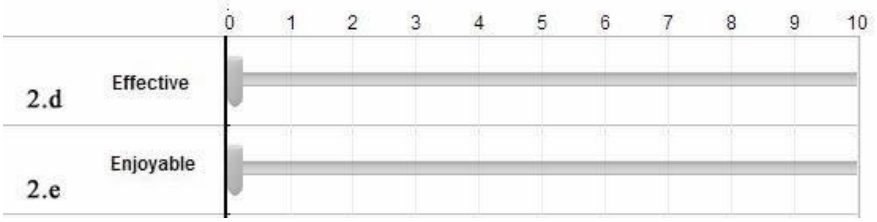
   The methods I practiced during the training were:



   (Questions 2.d and 2.e)

   Please rate each of the items below, where "0" is Strongly Disagree and "10" is Strongly Agree. Select your rating by sliding the bar.

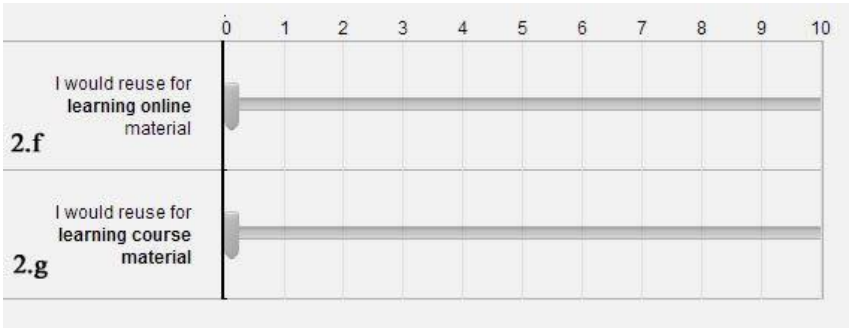
   Rate the study methods used during the training for learning the ape material:



   (Questions 2.f and 2.g)

   Please rate each of the items below, where "0" is Strongly Disagree and "10" is Strongly Agree. Select your rating by sliding the bar.

   Rate the study methods used during the training for future learning:



3. In the text box below, please describe in a step by step fashion how you studied the materials on Apes. Provide details about the steps you took. Please be specific.

4. Would you be interested in learning about a study method that would assist you when learning from multiple online resources?
    a. Yes
    b. No

Appendix E.2

Post Survey (Experimental)

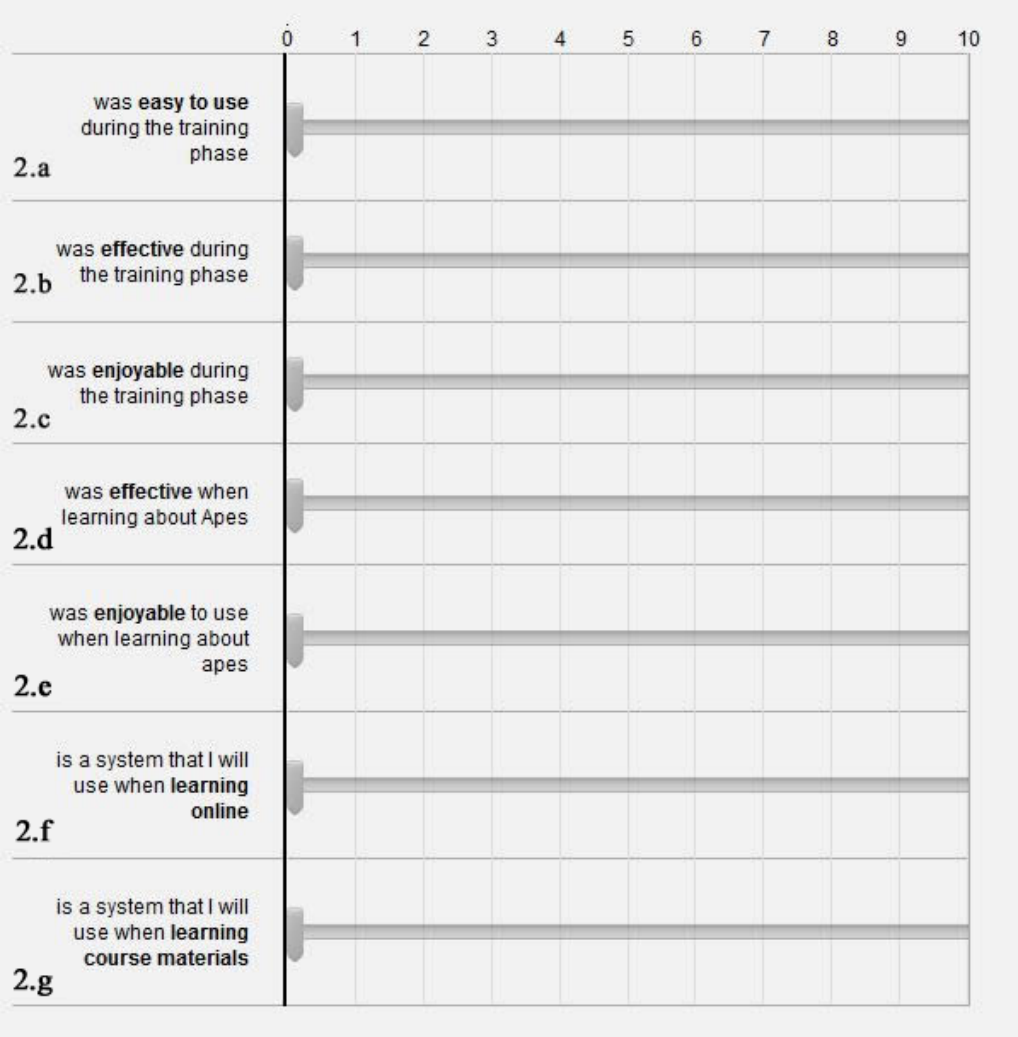
Post survey (experimental)

1. Please provide the number assigned to you in the text box below. This number is located on the first page of your notepad.

2. (Questions 2.a – 2.g)

   Please rate each of the items below, where "0" is Strongly Disagree and "10" is Strongly Agree. Select your rating by sliding the bar.

   The SOAR study system shown to me:



3. In the text box below, please describe in a step by step fashion how you studied the materials on Apes. Provide details about the steps you took. Please be specific.

4. Which of the four SOAR components was **most** useful?
    a. Select
    b. Organize
    c. Associate
    d. Regulate
5. Why was this component **most** useful?

6. Which of the four SOAR components was **least** useful?
    a. Select
    b. Organize
    c. Associate
    d. Organize

7. Why was this component **least** useful?

Appendix F

Interview Protocol

Interview protocol (IP)

This interview is part of a dissertation research project. The purpose of the interview is to gather information about personal reactions of students regarding their experience learning from multiple online resources.

Interviewee information:

Number: _____
Name: _____
Date: _____
Time: _____
Site: _____

Introduction

You have been selected to speak with me today as a student participant in the online learning experiment. You have been selected based on the group you were in and the answers to your test. This research project focuses on improving learning from online resources, specifically the steps you take when conducting research online. This interview will have no impact whatsoever on your course evaluation or assessment. It is simply an attempt to learn about your personal reactions in the experiment that you have participated in. Shall we begin?

(Interview questions on the following page)

Interview Questions:

1. How much effort did you put forth in this activity in general? Did you put more effort in the training phase or the activity phase of the experiment? *(Control & Experiment)*
    a. Do you believe your performance would have been better if you would have put in more effort? Why? *(Control & Experiment)*
    b. Do you believe your performance would have been the same, better, or worse if you would have not followed the steps of SOAR? Why? *(Experiment)*
2. Tell me something about how you learn online? *(Control & Experiment)*
3. Could you describe your method, strategy or protocol when learning from multiple online resources what steps are involved? *(Control)*
4. How did you learn to follow these steps? *(Control)*
5. Could you describe the steps you followed when learning the material on apes in the experiment? Please be specific. (*Control and Experiment*)
6. Please describe to me how useful or disadvantageous was the SOAR method in helping you learn? (*Experiment)*
7. Could you describe to me what you feel SOAR helps you accomplish? (*Experiment)*
8. How does learning SOAR make you think about the process of taking notes from online resources differently? (*Experiment)*

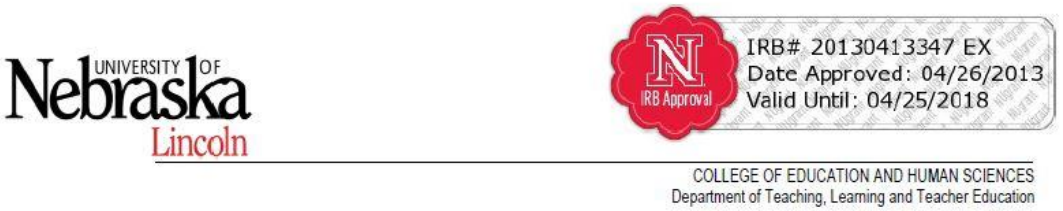
9. You were introduced to four SOAR components (steps) (Select, Organize, Associate, Regulate) did you feel one component was more useful or relevant to you than the others? If yes, what do you believe makes it the most useful? Were there any components that were least useful? If yes, what do you believe makes it least useful? (*Experiment)*
10. Now that you are familiar with SOAR, how likely are you to use it when you are learning from the web or conducting online research in the future? Could you explain your reasons? (*Experiment)*

I would like to thank you for your time and willingness to participate in this study. If you are interested in learning about the results of this research, please feel free to contact me at any time.

Appendix G.1

Participant Informed Consent Form for Interview

Appendix G.1 – Participant informed consent form for interview



Participant Informed Consent Form

Research Title:

AN INVESTIGATION OF THE SOAR STUDY STRATEGY FOR LEARNING FROM MULTIPLE ONLINE RESOURECES

Purpose of the Research:

The purpose of this dissertation is to explore learning from multiple online resources. The purpose of this study requires a sequential explanatory mixed method research design. You are invited to participate in this study because you are a student at University of Nebraska-Lincoln. If you are an undergraduate student under the age of 19 you may participate in this study. A waiver of parental consent was granted by the IRB.

Procedures:

You are asked to participate in a follow up interview after the completion of the step. You are asked to interview because of a variety of variables including the group you took part in and the answers in your test. You will be asked to give permission to use the data for presentations and publications. By signing this consent form you agree to take part in this interview and you give your permission to have the audio recorded.

Risks and/or Discomfort:

There are no known risks or discomforts associated with this research.

Benefits:

Your participation in this research may help you better understand your own attitudes and beliefs towards learning online from multiple resources. Taking part in this study will better the understanding of learning from online resources among college students.

Confidentiality:

Any information obtained during this study which could identify you will be kept strictly confidential. This study is distinctive. You will be asked to provide contact information and your name. Only the investigator will have access to the data. The audio recording will be saved in an encrypted folder on the investigators personal computer up to six months and then the recordings will be destroyed. Your name will not be stated in the published report. Information obtained through the interview may be published in scientific journals or presented in scientific meetings, but the data will be reported in a way that preserves anonymity as aggregated data.

Compensation:

You will not receive compensation for participating in this study.

Opportunity to Ask Questions:

You may ask questions concerning this interview and have those questions answered before agreeing to participate in or during the interview. Or you may call the investigator at any time (402) 472-4355, or after hours (402) 610-9031. If you have questions concerning your rights as a research subject that have not been answered by the

investigator or to report any concern about the study, you may contact the University of Nebraska-Lincoln Institutional Review Board, telephone (402) 472-6965.

Freedom to Withdraw:

You are free to decide not to participate in this interview or to withdraw at any time without adversely affecting your relationship with the investigator or the University of Nebraska-Lincoln. Your decision will not result in any loss or benefits to which you are otherwise entitled.

Consent, Right to Receive a Copy:

You are voluntarily making a decision whether or not to participate in this study. Your signature certifies that you have decided to participate having read and understood the information presented. You will be given a copy of this consent form to keep.

_____ _____

Signature of Research Participant Date

Name and Phone Number of Investigator:

Tareq Daher, Primary Investigator
Office: (402) 472 4355

Allen Steckelberg, Secondary Investigator
Office: (402) 472 5491

Appendix G.2

Participant Informed Consent Form for Study

Participant informed consent form for study

Participant Informed Consent Form

Research Title:

AN INVESTIGATION OF THE SOAR STUDY STRATEGY FOR LEARNING FROM MULTIPLE ONLINE RESOURECES

Purpose of the Research:

The purpose of this dissertation is to explore learning from multiple online resources. The purpose of this study requires a sequential explanatory mixed method research design. You are invited to participate in this study because you are a student at University of Nebraska-Lincoln. You must be 19 years of age or older to participate in this study.

Procedures:

Participation in this study will require your attendance on one day. On that day you will spend approximately an hour and forty five minutes of your time. You will be asked to fill a pre-survey and then complete a note-taking task and participate in a test. You might be asked to participate in a follow up interview after the completion of the test. This

interview will be conducted on a different day. Participants asked to interview will be selected according to a variety of variables including the group you took part in and the answers in your test. You will be asked to give permission to use the data for presentations and publications. By signing this consent form you agree to take part in a survey aimed at gathering demographic data and you give your permission to gather the notes that you take during the experiment.

Risks and/or Discomfort:

There are no known risks or discomforts associated with this research.

Benefits:

Your participation in this research may help you better understand your own attitudes and beliefs towards learning online from multiple resources. Taking part in this study will better the understanding of learning from online resources among college students.

Confidentiality:

Any information obtained during this study which could identify you will be kept strictly confidential. This study is distinctive. You will be asked to provide contact information and your name. Only the investigator will have access to the data. The survey results will be hosted on a secure server up to six months and then the data will be destroyed. Your name will not be stated in the published report. Information obtained through the survey, notes and the test may be published in scientific journals or presented in scientific meetings, but the data will be reported in a way that preserves anonymity as aggregated data.

Compensation:

Your instructor might select to provide extra credit for your participation in this study. The extra credit will not exceed 2% of your total grade. Others in your class will receive the opportunity to take part in a non-research activity of equal time and effort.

Opportunity to Ask Questions:

You may ask questions concerning this study and have those questions answered before agreeing to participate in or during the study. Or you may call the investigator at any time (402) 472-4355, or after hours (402) 610-9031. If you have questions concerning your rights as a research subject that have not been answered by the investigator or to report any concern about the study, you may contact the University of Nebraska-Lincoln Institutional Review Board, telephone (402) 472-6965.

Freedom to Withdraw:

You are free to decide not to participate in this study or to withdraw at any time without adversely affecting your relationship with the investigator or the University of Nebraska-Lincoln. Your decision will not result in any loss or benefits to which you are otherwise entitled.

Consent, Right to Receive a Copy:

You are voluntarily making a decision whether or not to participate in this study. Your signature certifies that you have decided to participate having read and understood the information presented. You will be given a copy of this consent form to keep.

_____ _____

Signature of Research Participant Date

Name and Phone Number of Investigator:

Tareq Daher, Primary Investigator
Office: (402) 472 4355

Allen Steckelberg, Secondary Investigator
Office: (402) 472 5491

Appendix G.3

Initial Instruction for the Experiment

Initial instructions for the experiment

The goal of this research project is to understand students' learning from online resources. This project will take about 2 hours of your time.

Before we begin, please listen carefully to the following instructions:

a) Make sure that you have a note pad, a red pen, and a blue pen. These should have been provided to you when you first arrived to the lab. Test the pens to make sure they write. If a pen is not working, please ask the researcher for another one.

b) Make sure that you know your assigned number. This number is your identifier in the experiment. This number is written on the first page of your notepad. You will be asked to use this number later on in the experiment.

c) Please do not touch your mouse or keyboard unless you are instructed to.

d) Please do not hit the "back" button on your browser at any point during this presentation and refrain from pushing the "backspace" button on your keyboard.

e) Is your cell phone shut off? Please do not use your phone or Tablet at any point during this experiment. I encourage you to put them away for the time of the experiment.

f) Did you sign a consent form when you entered the lab ? If you did not, please inform the researcher or lab assistant.

g) Your participation is valuable to this research. To qualify for extra credit in your course, your participation should be evident throughout the entire experiment.

In a few moments you will be instructed to click on the "Start" button showing on your screen.

Appendix H

IRB Approval

University of Nebraska Lincoln

April 26, 2013

Tareq Daher
Teaching, Learning and Teacher Education
1520 N 20th Cir, UNL, 68588-8307

Allen Steckelberg
Teaching, Learning and Teacher Education
59 HENZ, UNL, 68588-0355

Project Title: AN INVESTIGATION OF THE SOAR STUDY STRATEGY FOR LEARNING FROM MULTIPLE ONLINE RESOURECES
Dear Tareq:
This letter is to officially notify you of the certification of exemption of your project by the Institutional Review Board (IRB) for the Protection of Hum an Subjects. It is the Board's opinion that you have provided adequate safeguards for the rights and welfare of the participants in this study based on the information provided. Your proposal is in compliance with this institution's Federal Wide Assurance 00002258 and the DHHS Regulations for the Protection of Hum an Subjects (45 CFR 46) and has been classified as Exempt Category 2.

You are authorized to implement this study as of the Date of Exemption Determination: 04/26/2013.

1. The approved informed consent documents have been uploaded to NUgrant (file with -Approved.pdf in the file name). Please use these documents to dis tribute to participants. If you need to make changes to the documents, please submit the revised documents to the IRB for review and approval prior to using them.
We wish to remind you that the principal investigator is responsible for reporting to this Board any of the following events within 48 hours of the event:
* Any serious event (including on-site and off-site adverse events, injuries, side effects, deaths , or other problems) which in the opinion of the local investigator was unanticipated, involved risk to subjects or others , and was possibly related to the research procedures ;
* Any serious accidental or unintentional change to the IRB-approved protocol that involves risk or has the potential to recur;
* Any publication in the literature, safety monitoring report, interim result or other finding that indicates an unexpected change to the risk/benefit ratio of the research;
* Any breach in confidentiality or com prom is e in data privacy related to the subject or others; or

* Any com plaint of a subject that indicates an unanticipated risk or that cannot be resolved by the research staff.
This project should be conducted in full accordance with all applicable sections of the IRB Guidelines and you should notify the IRB immediately of any proposed changes that m ay affect the exempt status of your research project. You should report any unanticipated problem s involving risks to the participants or others to the Board.
If you have any questions, please contact the IRB office at 472-6965.
Sincerely,

Becky R. Freeman, CIP for the IRB

Appendix I.1

Script to be Used by Instructors (Invitation)

Extra Credit

Script to be used by instructors (invitation) – extra credit

Hello Everyone,

Tareq Daher is a graduate student conducting a study on improving online learning. You are invited to participate in this research study. The study aims at gathering data representative of college students. You will get the opportunity to take part in training on online learning and then you will be asked to take a short exam. There are no known risks for participating in this study. If you select to participate in this study, it will count as extra credit in the amount of **(# here, no more than %2).** If you select not to participate in this study but will like to earn extra credit in this course, you may complete the **(extra credit activity here).** The researcher expects that this study will require around one hour and a half of your time.

If you agree to participate, the information you give during this study will be used only in anonymous form and will be treated as confidential. You might be selected to provide your opinions further in a one on one interview with the researcher. Notes that you take during this study will be kept in a locked cabinet and audio recordings from the interview will be kept in an encrypted folder on the researcher's personal computer and destroyed at the completion of the study. Any details that might identify you will not be shared with me, the class or other individuals.

You should feel free not to provide any information you do not wish to share with the researcher or if selected for the interview, you can end the interview at any time. If you wish to end the interview early, any information you have provided up to that point

will be included in the study data unless you ask the researcher not to include it. Do you have any questions about the purpose or the process?

Is there anything else you would like me to clarify? If you have any concerns about your treatment or rights as a research participant, you can contact the Institutional Review Board at 402-472-6965

Appendix I.2

Script to be Used by Instructors (Invitation)

No Extra Credit

Script to be used by instructors (invitation) – no extra credit

Hello Everyone,

Tareq Daher is a graduate student conducting a study on improving online learning. You are invited to participate in this research study. The study aims at gathering data representative of college students. You will get the opportunity to take part in training on online learning and then you will be asked to take a short exam. There are no known risks for participating in this study. Your participation will not affect your grade in this course in anyway. Your participation is completely voluntary. The researcher expects that this study will require 2 hours of your time.

If you agree to participate, the information you give during this study will be used only in anonymous form and will be treated as confidential. You might be selected to provide your opinions further in a one on one interview with the researcher. Notes that you take during this study will be kept in a locked cabinet and audio recordings from the interview will be kept in an encrypted folder on the researcher's personal computer and destroyed at the completion of the study. Any details that might identify you will not be shared with me, the class or other individuals.

You should feel free not to provide any information you do not wish to share with the researcher or if selected for the interview, you can end the interview at any time. If you wish to end the interview early, any information you have provided up to that point will be included in the study data unless you ask the researcher not to include it. Do you have any questions about the purpose or the process?

Is there anything else you would like me to clarify? If you have any concerns about your treatment or rights as a research participant, you can contact the Institutional Review Board at 402-472-6965

Appendix J

Script for Email Invitation for Interview

Script for email invitation for interview

Dear Participant,

Thank you for participating in the study on improving online learning. Your participation was important to us. As we mentioned at the beginning of the study, some participants might be needed to help us further understand the results. You have been selected for this process. If you agree to further your participation you will be asked to take part in an interview. I expect this interview will not take longer than 30 minutes of your time. The interview will be conducted in my office on the UNL campus. Anything you share during the interview will remain confidential. The audio of the interview will be recorded. The recordings will be stored on my personal computer in an encrypted folder and no one will be able to access this file. The recordings will be destroyed upon the completion of the study. If you have any questions about this process please feel free to contact me at any time. My contact information is below.

Your participation in this interview will help us further understand the results and provide us with a clear picture of the statistical analysis phase; however your participation is completely voluntary. You will not be required to provide any information that you would not like to provide and you can decide to end the interview at any time.

If you agree to participate we can agree on a time and date to meet. Before the interview begins I will ask you to sign a consent form allowing me to use the gathered data in the interview.

Thank you for your assistance.

Tareq Daher
Phd Candidate, Instructional Technology
TEAC 135
Office: 402 472 4355
Cell: 402 613 9031

Appendix J.1

Website Text: Gibbons

Website text: gibbons

Gibbons are light skinned social apes from the super family Homonoidea. They belong to the lesser apes' family of the Genus Hylobates. They live in small, stable family groups and can live up to 15 years in the wild and 20 years in captivity.

Gibbons are well known for being arboreal; they are considered very acrobatic primates. They spend most of their lives in trees and are considered tree dwelling apes. Because they are so dexterous while moving in the trees, almost no predators can catch them. This ape moves within a tree or from one tree to another, they can reach speeds of 35 mph. Because of their small sizes their only protection comes from brachiating away when confronted. Gibbons are very small and lightweight. They are about 2 feet tall and weigh about 20 pounds.

Unlike most apes, gibbons do not make "sleeping nests." They sleep in groups huddled together in a fork between branches. They sleep sitting upright. Each morning upon awakening a group of gibbons loudly announces its presence in the forest with load squealing sound. A gibbon group has a territory of about 15 square miles of old-growth rain forest.

They cannot swim and choose to stay away from bodies of water, but because they are omnivores that eat both plants and meat, they can survive in several areas of a forest.

Appendix J.2

Website Text: Orangutans

Website text: orangutans

The word orangutan means "man of the forest" in the Malay language. Orangutans are large low land apes that live close to the ground most of their lives. They have dark reddish brown hair. Their life span in the wild is only 30 years (like most animals, they live longer in captivity about 50 years). The orangutan can reproduce at an age of 6 years.

They can sometimes be found in trees. They enjoy swinging from branch to branch using their arms, although there are not as gracious as some of the other apes. They can reach a speed of 15 mph.

Orangutans are omnivores (they eat both plants and animals). They eat fruits, plant bulbs, tender plant shoots, and flowers. They also eat insects and small animals (like birds and small mammals). Orangutans can drink water that has collected in the holes between tree branches. They do not like bodies of water and although they can swim, they will only swim if they need to.

Orangutans are shy, solitary animals that are active during the day. They live alone in large territories. This is probably due to their eating habits; they need a large area sometimes up to 50 miles in order to get enough food and too many orangutans in one area might lead to starvation. Only when under attack, they have been known to gather in their groups and make loud noises to scare others away. They weight an avg of 200 pounds with an avg height of 5 feet.

Each evening, orangutans construct a large round "sleeping nest" between the highest tree branches. They spend the night curled up and sleeping in their own nests.

These nests are made out of leaves and branches. These apes are solitary sleepers. Sometimes, the orangutan will use a leaf as a "roof" to protect itself from the rain. Each nest is occupied by one Orangutan at a time.

Orangutans belong to the Super family Homonoidea of the greater ape family from the Genus Pongo.

Appendix J.3

Website Text: Siamangs

Website text: siamangs

Siamangs are very acrobatic primates. Siamangs can grasp and carry things with both their hands and their feet. Because they are so dexterous while moving in the trees, almost no predators can catch them. They can reach 25 mph moving in the trees.

When it comes to size, Siamangs are about 3 ft tall and weigh an average of 30 pounds. Their diet consists of eating plants and small animals. They are omnivores. They forage for food in the forests during the day, eating fruit (which constitutes about 75% of their diet), leaves, flowers, seeds, tree bark, and tender plant shoots. They also eat insects and spiders.

They avoid bodies of water but for drinking because they cannot swim. Siamangs are social animals that a live in small, stable family groups. A Siamang family has a territory of about 20 miles of old-growth rain forest. Each morning upon awakening a family group of gibbons very loudly announces its presence in the forest, using a loud squealing sound. They are covered with black hair on most of their body.

Siamangs live about 20 years in the wild. They do not do very well in captivity and live for only 5 years.

Siamangs are small dark apes that belong to the Super Family Homonoidea from the Lesser apes family (meaning "tree dweller") of the Genus Hylobates.

Appendix J.4

Website Text: Gorillas

Website text: gorillas

Gorillas are social animals that live in small groups. Each evening, gorillas construct a "nest" for the night in which they will curl up and sleep. Each gorilla will sleep in his/her own nest Scientists who study gorillas can easily estimate a local gorilla population by counting the number of "nests."

Gorillas belong to the Homomonoidea Super Family of the greater apes family from the Genus Gorilla. They can weight 300 lbs and are on average at 6 feet tall. Despite their size, they rarely attack other animals. When an intruder disturbs them, they may gather in their group and make a lot of noise. They live for 40 years in the wild and can reach 60 years in captivity. Gorillas are covered with dark blackish hair on most of their body. Adult male gorillas are called silverbacks because they have a patch of silver hair on their backs after they are about 12 years of age.

Some gorillas have been taught to use tools by people when in captivity. Despite their intelligence in captivity, Gorillas have never been observed using tools in the wild. Gorillas are herbivores, eating mostly plant material.

They are considered low land animals that spend most of their times on the ground. They move from one area to another and can have a range of 70 square miles. Gorillas knuckle-walk using both their legs and their long arms (putting pressure on their knuckles, with the fingers rolled into the hand). They can climb trees, but do not do so very often they can reach high speeds on ground but average 10 mph when brachiating in the trees at full speed. Gorillas can swim and are able to cross any body of water.

Appendix J.5

Website Text: Chimpanzees

Website text: chimpanzees

Chimpanzees stand tall at 4 feet and weight an average of 110 pounds. They are covered with dark black hair on most of their body. They do very well in captivity and live about 45 years. They only live about 25 in the wild. Chimpanzees are omnivores, eating plants and meat.

These apes live in a variety of environments but are considered low land apes. This means that spend most of their time close to the ground. They spend most of the day in their groups. While in their groups they typically cover 40 miles of forest. If a river crosses their territory they are able to swim across it, but they are not great swimmers.

Chimpanzees belong to the greater ape family from the genus Pan of the super family Homonoidea. Humans and Chimpanzees are closely related. In fact, Chimpanzees is the closest to humans genetically. Humans and chimps have very similar DNA; about 98% of human and chimpanzee DNA is identical. Some genetic studies show that chimpanzees and humans share a common ancestor.

Chimpanzees construct a fresh "sleeping nest" in the trees where they will curl up and sleep. They sleep on their own and not within their groups. They are interesting apes to watch and observe because they can run on both of their legs. They can walk upright when they need to use their arms to carry something. They can swing from branch to branch in the trees; this is called brachiating. They can reach speeds of 20 mph. Chimpanzees are social animals and live in groups. When attacked by other predators they gather and make loud noises

Chimpanzees are very intelligent and can learn extremely complex tasks in the wild. They are known for using items they find in the wild in creative ways. For example, they have been observed using items from their environment to catch and eat insects.

Appendix K.1

Study Materials Scoring Rubric

Study materials scoring rubric

Table 10 - Complete list of facts provided from the texts.

Categories/ Ape	Gorillas	Orangutans	Chimpanzees	Siamangs	Gibbons
Super Family	Homonoidea	Homonoidea	Homonoidea	Homonoidea	Homonoidea
Family	Greater ape	Greater ape	Greater ape	Lesser ape	Lesser ape
Genus	Gorilla	Pongo	Pan	Hylobates	Hylobates
Weight (lbs)	300	200	110	30	20
Height (ft)	6	5	4	3	2
Life Span (wild)	40	30	25	20	15
Life Span (captivity)	60	50	45	5	20
Color	Black	Dark Reddish brown hair	Black	Black	white to light brown
Habitat	Low land	Low land	Low land	Tree dwelling	Tree dwelling
Diet	Herbivores	Omnivores	Omnivores	Omnivores	Omnivores
Social habits	Groups	Solitary	Groups	Groups	Groups
Sleep nest	Yes	Yes	Yes	No	No
Sleep behavior	Solitary	Solitary	Solitary	Group	Group
Avg. Speed in trees	10 mph	15 mph	20 mph	25 mph	35 mph
Swimming Ability	Yes	Yes	Yes	No	No
Defense Mechanism	Gather in groups and make noise	Gather in groups and make noise	Gather in groups and make noise	Brachiate away	Brachiate away
Morning call	none	none	none	Loud morning squeal	Loud morning squeal
Use of tools	captivity	none	Captivity and wild	none	none
Unique facts	knuckle walks	Reproduces at age 6	Closest genetics to humans	InflaTable Throat Sac	They sleep sitting upright
Unique facts	males have patch of silver hair	means "man of the forest"	Can run standing upright on both legs	N/A	N/A
Range (sq. miles)	70	50	40	20	15

1. **Select:**
    a. Students' selection of information was evaluated by the number of idea units in Table 14 which contains 5 x 21 idea units minus 2 idea units for a total of 103 idea units. (1 point per idea unit)
    b. Number of words used.
    c. Efficiency rating (average words used in an idea) = # idea units / # of words used (points)

2. **Organize:** Students' organization of information was evaluated by the frequency of:
    a. Apparent graphic organizers such as matrices, Tables, concept maps or others.(1 point)

    b. Number of ideas contained in organizers (1 point per idea unit)

3. **Associate:** Students' association of information is evaluated by the number of associations evident in the text; Two types of associations are evaluated:
    a. Local associations: associations across a Row in Table 14 (1 point per association)
    b. Global associations: associations created across two or more columns, Rows or a combination of columns and Rows (1 point per association).
    c. Frequency: Total Number of cells involved in each association

Local Association Examples from Ape Text:

- ☐ All apes belong to the super family Homonoidea.
- ☐ All apes range between 20 to 300 pounds in weight.
- ☐ All apes range between 2 to 6 feet tall.
- ☐ All apes live between 5 to 40 years in captivity.
- ☐ All apes live between 20 to 50 years in the wild.
- ☐ Four apes have dark colors.
- ☐ Four apes are Omnivores.
- ☐ Four apes live in Groups.
- ☐ Three apes create sleeping nests
- ☐ Two apes do not create sleeping nests
- ☐ All apes have a speed range between 10 to 35 mph in trees
- ☐ Three apes can swim
- ☐ Two apes cannot swim
- ☐ Three apes Gather in groups and make noise when attacked
- ☐ Three apes do not use tools in the wild or captivity

Global Association Examples from Ape Text:

- ☐ The greater apes weight more than the lesser apes
- ☐ The greater apes live longer in the wild than the lesser apes
- ☐ The greater apes are taller than the lesser apes.
- ☐ The lesser apes brachiate faster than the greater apes
- ☐ Low land apes weight more than tree dwelling apes
- ☐ Low land apes live longer than tree dwelling apes in the wild.
- ☐ Low land apes are taller than tree dwelling apes
- ☐ The smaller the ape the faster it can brachiate.
- ☐ Apes with the most weight live longer in the wild.
- ☐ All of the lesser apes are Omnivores.
- ☐ All apes from the Genus Hylobates are Omnivores
- ☐ All of the lesser apes stay in their groups during the day and night; none of the greater apes stay in the groups at night.
- ☐ All of the tree dwelling apes stay in their groups during the day and night, none of the low land apes stay in their groups at night.
- ☐ All of the lesser apes have a loud morning squeal.
- ☐ All of the tree dwelling apes have a loud morning squeal.
- ☐ All of the greater apes make sleeping nests to sleep in; none of the lesser apes make sleeping nests.
- ☐ All of the low land apes make sleeping nests to sleep in, none of the tree dwelling lesser apes make sleeping nests.
- ☐ All apes from the Genus Hylobates sleep in sleeping nests.
- ☐ The greater apes can swim; the lesser apes from the cannot.
- ☐ Low land apes can swim; tree dwelling apes cannot.
- ☐ The greater apes from the defend themselves by gathering into groups and making loud noises; the lesser apes from brachiate away.
- ☐ Low land apes defend themselves by gathering into groups and making loud noises; the tree dwelling apes brachiate away.
- ☐ The greater apes have a wider range than the lesser apes from the.
- ☐ The low land apes have a wider range than the tree dwelling apes
- ☐ The greater apes live longer in the wild and weight more than the lesser apes
- ☐ The greater apes live longer in the wild and brachiate slower than the lesser apes.
- ☐ The greater apes can swim and sleep in sleeping nests; the lesser apes cannot swim and they do not sleep in sleeping nest.

- ☐ Low land apes defend themselves by gathering into groups and making loud noises and they are slower at brachiating; the tree dwelling apes brachiate away when confronted and they are faster at brachiating than the low land apes.

4. **Regulate:** Students regulation will be evaluated on
    a. The number of generated questions (1 point per question)
    b. Frequency:
        i. the number of fact questions generated (1 point per question)
        ii. the number of relationship questions generated (1 point per question)

Appendix K.2

Relationship Items Rubric

Relationship items rubric

Question / Grade	2 (complete)	1 (Incomplete)	0 (Incorrect)
Q1	All apes range between 2 to 6 ft in height	Stating the height of each ape	Incorrect association
Q2	All apes live between 5 to 40 years in the wild.	Stating the life span in the wild for each ape	Incorrect association
Q3	4 of the 5 apes are Omnivores.	Stating each ape and his/her diet.	Incorrect association
Q4	3 of the 5 apes swim	Stating each ape and if they can or cannot swim	Incorrect association
Q5	4 of the five apes have dark colored skin.	Stating each ape and their skin color.	Incorrect association
Q6	The more an ape weighs the longer the life span in the wild.	Stating the apes' weight and life span in the wild	Incorrect association
Q7	The more an ape weighs the slower s/he can swing in the trees.	Stating each apes' weight and their speed	Incorrect association
Q8	Apes who sleep in sleeping nests can swim	Stating each apes' sleeping condition and ability to swim	Incorrect association
Q9	All apes from all greater apes gather in groups and make noise when attacked. All apes from the lesser apes brachiate away.	Stating each apes' family and defense mechanism	Incorrect association
Q10	Apes from the Greater Ape family create sleeping nest. Apes from the lesser apes do not.	Stating each apes' family and sleeping condition	Incorrect association

Appendix L.1

General Instructions for the Control Group Training Material

General instructions for the control group training material

During this phase of the experiment you will be given 3 passages to study, one at a time.

As you study each passage, you can make study notes on the provided notepad.

After studying each passage, you will be asked to recall the information from memory.

Appendix L.2

Instructions for the Experimental Group Training Material

Instructions for the experimental group training material

Training in SOAR

- In the following tutorial, you learn about a study method called SOAR.
- You learn how to use the method and have an opportunity to practice it.
- Later, you will use the SOAR method to study some materials that you will be tested on.

Appendix M

Key Term

Key Term Definitions

Offline Website:

An offline website is a website that is stored locally on a computers' hard drive. The website does not need an Internet connection to function. For the purpose of this dissertation, an offline website was created to host the materials needed in this research experiment. The website mimics in its design and navigation the functionality of an online website. An offline website does not interfere with a page's navigation.

Hyperlink:

is "an area in a hypermedia document which normally points to another part of the document or to another, separate, document" (Ince, 2001). To navigate between hypermedia documents, one can tap on touch screen mobile devices or click on a hyperlink with a mouse. For the purpose of this research, an offline website was created. Relative hyperlinks were used for navigation purposes without an online connection for control purposes. Use of external hyperlinks was limited.

Search Engine:

is a computer program that searches documents on the Internet, for a specified word or set of words and provides a list of results in which they are found ("Search Engine," 2012) . Search engines work by fetching as many matches in documents as possible. This operation is followed by another program called an *indexer* that reads the documents and creates an index based on the words found in each document. Examples of search engines or

service providers that host them are Bing, Google, and Yahoo. An offline website was used in the experiment phase of this dissertation. It resembles in its design a page containing a list of results from a search engine.

Keywords:

In text editing and database management systems, a keyword is an index entry that identifies a specific record or document. Words or phrases entered into a search engine are used to obtain hit lists (Steinbeck, 2000). For the purpose of content control in this experiment the website will indicate a list of results based hypothetical keywords relevant to the study material.

Online Prose:

"material presented on computers in linear form"(Jairam, 2009). Online prose typically represents non-interactive text presented on a computer screen. In order to view the text one must scroll vertically.

SOAR:

is a systematic study plan and learning method developed by Kiewra (2004) based on Mayer's (1996) SOI study system. SOAR comprises of the following components *Selection*, *Organization*, *Association,* and *Regulation*. Jairam and Kiewra (2009) described how each component relates to the cognitive learning process in Table 37 below.

Table 11- SOAR components and cognitive learning processes

	Select	**Organize**	**Associate**	**Regulate**
Cognitive Process	Attention	Storage	Encoding	Metacognition
What students do wrong	Fail to record complete notes	Rely on lists and outline	Rely on piecemeal learning	Fail to monitor their learning
How SOAR can Help	Select and note all important ideas	Organize ideas using Graphic organizers	Associate new ideas with each other and with things already known	Regulate and monitor learning by generating practice test questions

**Adapted from Jairam and Kiewra (2009)*

Appendix N.1

Examples of Student Answers to Question 8 in the Pre-survey

Examples of student answers to question 8 in the pre-survey

1. "*I would either find an online database or a reliable website from google to gather information. I would check out multiple websites and choose the top three or four websites to use. I like to print to the pages and highlight the important things. It makes it easier to remember them that way*."

2. "*First I would google the subject matter and see what comes up. I would just use that as a background knowledge to find useful websites. Then I would most likely go to the UNL Libraries website to get better information about the topic. Then I would write down with a pencil a brief outline of the information and go over the outline as many times as I need to memorize what's in it.* "

3. "*I would look at all the websites and figure out which site had the most credible data and go from there. Sometimes I look up vids from youtube and summarize what I see there in my notes. I put everything in word and print it. If I want to memorize what is in them, I would highlight the notes and go from there.*"

4. "*I would first find viable websites with good credential to base my research off of from Google or the University's library. Then I would gather all of the pertinent information from the different websites and begin to form my research. Once I had gathered all of the necessary information, I would study from the notes that I had gathered*."

5. "*First I would open a major search engine such as Google and enter the topic I am researching / Next I would skim the page for websites that end in .edu, .net, or .org - those are usually more reliable than a .com website / Then I would compile the information I took from each website into notes and turn it into the final project whether it's a paper, powerpoint, etc.*"

6. "*I would google the subject matter and I would pull up several sites. I would do this to make sure I have enough information on my topic and that I am getting the information from the reliable ones. Also, I would do this to make sure I had correct information. Then I copy everything important to me to Word and read it a few times until it is easy to recite what it is in the word doc*."

7. "*I would first figure out what main ideas I need to learn about each topic. Next, I would go on each website to find out what information is provided on each one. Lastly I would revisit each website and take notes on the important information provided about the topic I am studying. If I have to present this in class I would memorize my notes so my presentation will be good*."

8. "*I would take notes from every website that I researched. Then I would make sure all the information is legit. After I make sure all the stuff is true I would then study all of the notes and webpages that I researched and try to learn my notes by heart*."

9. "*I would first go to Google. Then I would type in the topic or subject into the search bar. Once all of my results would pop-up i would look for the website that looks the most reliable and collect my information from there. Then I would put everything in word so I can save my notes for later*."

10. "*Search Google for credible websites. Then read all websites carefully and compare the information provided. After having an idea of everything I would take notes about everything I read. I try to write down the important and useful things. Then I would spend time going over my notes until I know what is in them."*

11. "*First I would google it to find different websites about the topic. Then I would read threw the websites to find the information I needed then copy the information into my Word and after that I would begin the project or homework assigned to me*"

12. "*1. First I would scan through websites from Google and see which ones best relate to my topic. / 2. Second I would take the websites that are most helpful to me and use key info / 3. Next I would cite my sources of the info taken from each website if I have to turn it in. /4. I would go over my notes so that I know exactly what I wrote down*."

13. "*…I would skim the results for websites that I believe are reliable. It is easy to find those because you can read the short description about a website before you open it*"

14. "*I would first google the information I was asked to research and find several credible sources. I make those my favorite bookmarks. Then I would then read the articles and take notes on what I find as important. Condense the information into a summary that I understand and then I would nail down everything in my notes until I can recall it all*."

15. "*I would go to google and look for legit websites and maybe go to youtube to see if there is information useful to me there. I would read through the information and I would write down detailed notes. Once I am done reading through it once, sometimes I will read through it another time*."

16. "*I typically go to a reliable database such as the university's library website and do a search, browse the results, read through the results that seem fitting and*

useful, take notes or print off articles/webpages that pertain to what I was studying then summarize the information in my notes."

17. "*I would search the internet using google or youtube for the topic or subject matter and then proceed to open the websites that seem to have the most reliable sources in new tabs on the page. Then I would go through and read each website for the information I was looking for. When I find the information I write it down and go over it until I have it all memorized*."

18. "*I would go to the website and skim it over looking for things that apply to what we are learning. Then after that, I would go to those parts of the website and read over what it says. As I was looking it over, I would take notes about the things that stood out as being important to me. If I find a site with a lot of information that I like I would copy it into Word and highlight the important stuff*"

19. "*I would open up an internet browser, go to google.com, and search the topic. I would then select a few of the top recommended articles or readings from the first page of suggestions*"

20. "*First you should notes some important things that you find from the websites on google or things you can read from the university website. Second print the pages and then highlight the important things in them. After you've done this, you should write your notes on the printed page to see what you learned and review them until you master them.*"

Appendix N.2

Examples of Student Answers to Question 3 in the Post-survey

Examples of student answers to question 3 in the post-survey

1. "*I wrote down the information from the webpages that I found pertinent to what should be known on the test. I then made a chart categorizing all of the apes. I then attempted to relate them to things I already knew and to each other. Lastly I came up with a few test fact and relationship questions from my information."*

2. *"First I wrote down everything that seemed most important for each type of ape. I wanted to make sure my notes covered all the important information. Next, I put everything into categories under the names of the apes and made it into a graph so I could compare characteristics. By that time I had 10 minutes to start studying for the test."*

3. *"I opened up the website and for the first ape i wrote down a whole bunch of information I felt was important and would go hand in hand with the other apes. Then from there on I would add in all the details that corresponded with the information from all the other ones so that i could compare and contrast each detail. That's when I then made my chart to organize all of the ideas that I collected and studied. I had a better view of the information when I put it in the chart for the quick quiz that we took afterwards."*

4. *"First, I went through and listed all of the apes at once. I made a section for each ape and listed categories such as habitat, diet, height/weight, and lifespan beneath them. Once I had gone through and written down all of the material underneath the categories I started to organize the information in a Table to find similarities and differences. For instance, I noticed that Gorillas weighed the most at 300lbs and had the longest lifespan of 60 years in captivity while the Signmas weighed the least and had the shortest lifespan. Then I started looking for relationships from what I could see in the Table. I didnt write them, I just skipped to the last step and started quizzing myself, I wrote down only a couple questions."*

5. *"First I took down the main ideas of each ape and found common categories that were talked about for each ape. After that I made a chart of the common things that were talked about on each page. Next I wrote out how each ape was related to one another or how they were not related to one another. It was easy to see how they were related because of the Table I made. Then I wrote down some questions that I thought might come on the quiz."*

6. *"For the material on apes, I attentively read each article on each different species of apes. While reading them I took notes on areas i found as important. When I finished creating the Table I looked for relationships in the information I had and quizzed myself so I would remember them and from there I created possible test questions and quizzed myself over them as well."*

7. *"When studying the material on Apes I went to each site and wrote down which site was about which Ape. Then I wrote down what looked important. I started to notice a pattern in the websites and what the information they were giving me. I took all of these notes in list format and then transferred them to a chart. It was easy to put them into a chart because all of the websites had similar information. I noticed that there were relationships between the websites. Finally I created a list of fact questions about information that I thought would come on the test like chimps and humans have close DNA."*

8. "*First I made a list of important details from each of the websites. Next, I made a chart with all 5 apes listed on top with many categories going down the side. Because the information was given to us in a scattered fashion on the websites, making the chart helped organize it very well. I was able to easily compare and contrast in all of the categories on the chart. Next I wrote down important comparisons and general facts I had learned about the apes. The last thing I did was making up and answering a few fact questions about the apes."*

Appendix N.3

Examples of Student Answers to Question 5 in the Post-survey

Examples of student answers to question 5 in the post-survey

1. "*It was easier to see the information in a chart rather than searching for the relationships in my notes*."

2. "*It helped comparing to the other ideas to each other while also helping remember the most important ideas*."

3. "*better to see all information in a Table*".

4. "*This component made it so that I had to organize my information that i gathered which is a very good thing because I am not a very organized person and intern made the information easier to comprehend and study. I am sure without it I would not be able to answer a lot of questions on the test*"

5. "*Having information in an organized graph allows me to easily sort and identify various forms of information recorded in the select stage. It made it possible to see relationships between the apes*"

6. "*It made it a lot easier for finding exactly where my notes were and made it easier to compare everything."*

7. "*I'm a very visual learner, so things that are neatly organized and compared in charts work well with me and help me maximize my learning. I put all the facts for each ape under one column. The Table helped me review everything for the test*"

8. "*It made easy comparisons."*

9. "*organize was the most useful because it allowed me to see all the facts in one spot and therefore made it easier to associate things with each other*."

10. "*It was easier to compare all of the important facts about each of the different apes and help separate everything in an organized manner*."

11. "*I never thought about comparing the material I had in a graph until I did SOAR*."

12. "*It organized all of my messy notes into a chart that was easy to read and compare*."

13. "*It let's me see all the main ideas and concepts side by side and all in one area so I don't have to search for it when associating certain details and making possible test questions. I studied from my Table to be ready for the test*"

14. "*I like using a Table to learn information. It is much easier to study than notes in outline form*."

15. "*I thought when using this component it helped me better prepare for the test because I had all the information I needed in one place*"

Appendix N.4

Examples of Student Answers to Question 7 in the Post-survey

Examples of student answers to question 7 in the post-survey

1. "*It was hard to think of ways and examples of how they relate to what I already know* "

2. "*I believe I associate the material I learn with what I already know in my head. I felt like it was redundant to write it all out*."

3. "*I think this was the least useful because not all times will we already have previous knowledge of a similar subject that we could relate to the current topic."*

4. *"I feel like it gets away from the material that will be tested on. It's inconvenient and time-consuming when you've already learned the material to have to write down those associations"*

5. "*Because it was hard for me to think of things to associate with what I know*"

6. "*It is easy to associate items with other items in the learning being done, but there is not always a prior knowledge to relate to*"

7. "*I learn better when things are all organized, rather than trying to compare just certain aspects of things. Why should I write down relationships when I already figured them out*"

8. "*I feel like when I am studying content I am already associating it in my head and the organization shows the associations so that part seemed confusing and like a waste of time*."

9. "*I was already able to associate things while using my organize chart*."

10. "*I think this component was least useful because it was hard for me to come up with a lot of things to associate them together. It is still useful I just think it is the least useful of the four choices*."

11. "*It wasn't very useful because the information was provided in the organize part and it was kind of just repeating*"

12. "*Since I didn't have much background knowledge about the topics presented this wasn't very useful*."

13. "*It was a little helpful but I used the chart in the organize section to do the associating*"

14. "*I think this part is the least useful because if there is something that I already know, then I automatically in my head create that comparison when I am researching the material. Therefore, I feel that it is just unnecessary and somewhat a waste of time*."

15. "*Most of these topics I had little to no background knowledge on so it was hard to make associations*."

Appendix O.1

Inter-rater Reliability Table for Study Materials Rubric

Inter-rater reliability table for study materials rubric.

Table 12 – Inter-rater reliability for 2 raters in pilot study for the study materials scoring rubric.

N coder	2
n cases	9
n decisions	18
average pairwise percent agreement	88.89%
pairwise agreement cols 1 & 2	.88
fleiss' kappa	.86
FK observed agreement	.88
FK expected agreement	.18
average pairwise cohen's kappa	.87
pairwise CK cols 1 & 2	.87
krippendorff's alpha	.87

Data for inter-reliability for 2 raters:

# of ideas	44	44
# of words	89	89
Efficiency rating	2.02	2.02
Apparent organizer	1	1
# of cells	25	25
# of local associations	3	3
# of global associations	0	0
# of fact questions	1	2
# of relationship questions	2	2

Appendix O.2

Inter-rater Reliability Table for Study Materials Rubric

Intra-rater reliability table for study materials rubric.

Table 13 – Intra-rater reliability for the same data scored twice several days apart by the researcher.

N coder	2
n cases	9
n decisions	18
average pairwise percent agreement	88.89%
pairwise agreement cols 1 & 2	.88
fleiss' kappa	.86
FK observed agreement	.88
FK expected agreement	.18
average pairwise cohen's kappa	.87
pairwise CK cols 1 & 2	.87
krippendorff's alpha	.87

Data for intra-reliability:

# of ideas	21	21
# of words	67	67
Efficiency rating	3.1	3.1
Apparent organizer	1	1
# of cells	25	23
# of local associations	3	3
# of global associations	1	1
# of fact questions	2	2
# of relationship questions	1	1

Appendix O.3

Inter-rater Reliability Table for Relationship Items Rubric

Table 14 – Inter-rater reliability for 3 sets of data scored by three graduate students.

Krippendorffs' alpha (ordinal)	0.9
Krippendorffs' alpha (interval)	0.9
Krippendorffs' alpha (ratio)	0.9

Data from each data set for each grader below:

Set 1	Grader one	Grader two	Grader 3
Q.1	1	1	1
Q.2	2	2	2
Q.3	1	1	1
Q.4	2	2	2
Q.5	1	1	1
Q.6	**1**	**1**	**2**
Q.7	**0**	**1**	**1**
Q.8	0	0	0
Q.9	0	0	0
Q. 10	2	2	2
Set 2	Grader one	Grader two	Grader 3
Q.1	1	1	1
Q.2	2	2	2
Q.3	1	1	1
Q.4	2	2	2
Q.5	1	1	1
Q.6	**0**	**1**	**0**
Q.7	**2**	**2**	**1**
Q.8	0	0	0
Q.9	0	0	0
Q. 10	1	1	1
Set 3	Grader one	Grader two	Grader 3
Q.1	1	1	1
Q.2	2	2	2
Q.3	1	1	1
Q.4	2	2	2
Q.5	1	1	1
Q.6	**2**	**1**	**2**
Q.7	**0**	**1**	**1**
Q.8	0	0	0
Q.9	0	0	0
Q. 10	2	2	2